THE

RAILWAY MAGAZINE,

AND

Annals of Science:

CONTAINING

COPIOUS ACCOUNTS OF ALL RAILWAYS

AT HOME AND ABROAD;

NOTICES OF INVENTIONS, AND SCIENTIFIC DISCOVERIES.

BY JOHN HERAPATH, ESQ.

VOL. I.—NEW SERIES.

LONDON:

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DEDICATION.

TO HIS GRACE THE DUKE OF WELLINGTON,
&c. &c. &c.

My Lord Duke,

Men of the greatest experience and wisdom have acknowledged the importance of Railway communication. They have both seen and felt that, if judiciously managed, it will prove the key-stone of great and lengthened prosperity. However humble, therefore, the pretensions of this Work may be, the subject certainly is not; and it is on this ground that the First Volume of the Railway Magazine is now respectfully presented to your Grace, by,

My Lord Duke,

Your Grace's Obedient Humble Servant,

JOHN HERAPATH,
Editor and Proprietor.

Nov. 28, 1836.

PREFACE.

The Editor of the Railway Magazine has now brought the first Volume of the New Series to a close. He would be wanting in gratitude, if he did not return his cordial thanks to the public and his numerous and highly respectable Correspondents, for the support they have given him. He only regrets that the modesty of many of his Correspondents will not allow their names to appear. With respect to the public favour, this simple fact will be sufficient, namely, that nine months have seen the gross returns of the Work rise to between six and eight times what they were.

It does not become the Editor, who has contributed so largely to the scientific part of the Magazine, to speak of the merit of the articles, but it must be gratifying to his feelings to hear, that they are almost regularly translated into the German, Russian, and other languages—countries to which he could hardly have hoped even the name of the Railway Magazine would have reached.

To such liberality on the one hand, and compliment on the other, the Editor has no other means of responding but by an increase of exertion, which, he trusts, will not be found wanting.

Nov. 27, 1836.

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THE
RAILWAY MAGAZINE;

AND

Annals of Science.

No. I. MARCH, 1836. New Series.

ON RAIL-ROADS.

(No. I.)

WITH SOME REMARKS ON THE LIVERPOOL AND MANCHESTER RAIL-ROAD.—By the Editor.

Such is the ruling passion of the day for locomotives and rail-roads, that, to doubt of their utility is a serious offence; and to speak against their success absolute treason. Happily for me, I have always been too much a friend to steam, to be endangered by the consequences of so unpopular a crime. Neither do I think it matters much how, or upon what we use steam. What we want, is to avail ourselves of the services it can render us in the most economical, and therefore the most profitable way.

But we must not here take the word economy in its usual acceptation; for instance, in doing the greatest quantity of work at the least expense. When we apply this term to travelling by steam, it has a higher and more important signification. Time is what we want most to economise. It would be of small advantage indeed, to be able to travel or send goods from one town to another at a low expense, if the time was to be exceedingly prolonged. With diminution of expense, therefore, must be combined an increased rapidity of travelling, and thus the grand obligation which steam has to confer on us, is to abbreviate as much as possible the time of transit between distant places; and thus proportionally lengthen the term of our natural life. In this sense chiefly will it be economical and valuable, though we by no means disregard that which may properly be called the constant quantity of human nature—the love of our pockets. Probably of all the inventions to curtail time in travelling, that of rail-roads bids fair to be the most successful, and the most capable of farther improvement. Other methods may excel it in enabling us to go this way or that as we please, and in initial cost; but as to safety, comfort, and celerity of travelling between given points, I feel no hesitation in saying, from what I have myself seen,

that no method hitherto proposed, can equal that of a well-constructed rail-road. There is not, therefore, in my opinion, any doubt but that rail-roads will long hold a pre-eminence, and hence be a safe and stable investment for capital.

Improvements in stage coach travelling, have certainly gone on very rapidly of late. It is not very many years, since men used to jog on at the rate of about five miles an hour between London and Bristol, in certain six or eight wheeled coaches, which were humorously styled "Fromont's Wagons." And within a very few years there did, if it does not now, exist a two-horse coach, which took I believe three or four days to travel from the one city to the other. What would some of the gentlemen who used to patronize these conveyances, say to a coach starting from London or Manchester at a little before five in the morning, and reaching the other town, 186 miles distant, by eleven at night? What would they, who used to think ten minutes or a quarter of an hour to change horses, and an hour for dinner, unnecessary haste; now think of seventy seconds or less for the former, and ten or fifteen minutes for the latter? Our sailors themselves, would hear with astonishment a "lubberly" stage coachman talking of the difference of longitude of the places through which he passes, and demanding a deduction of nine minutes on his arrival in London, for the difference of longitude "in his run" from Manchester; yet such is actually the case. But if nine minutes be of importance in a run of eighteen hours, surely it will be of much more, in a run of only some five or six hours, when we come to have a rail-road. Intelligence will, doubtless keep pace with the improvement in travelling; it will all go on with a railway speed. In a few years, I expect to hear even the stokers of the engines, whose knowledge now, scarcely reaches beyond the distinguishing of a piece of coke from a clinker, talking as glibly of longitude as our men of science at present do. To some old commodore's wife, whose information has not kept pace with her years, and who, on arriving at Plymouth, complains that she is seventeen minutes behind the time, I fancy I hear some porter explaining to her the cause: "No ma'am, it is not our fault nor your watch's; it is all owing to the difference of longitude. We have travelled with the sun westward, and by your watch appeared to lose the seventeen minutes of time; if we had travelled eastward against it, we should have appeared to gain seventeen minutes, and you would then think you had arrived seventeen minutes too early."

I may possibly be excused for relating the following incident, which sets the "march of improvement" in travelling in an interesting light. Some years since, while I was in conversation with a gentleman on one of the coaches, he mentioned to me, that a few days before he had been comparing

two letters, one written by his great grandmother, dated from Salisbury, shortly after her marriage, and in the high day of youth. It complained that after three fatiguing days' journey, she and her husband had at length reached Salisbury from Bristol, in their own carriage, about sixty miles. The other was from his grandmother, the daughter of the above lady, then upwards of eighty years of age, who stated, that after a pleasant journey of three days, she was arrived in town from Edinburgh, a distance, not of sixty, but of near 380 miles! This was related to me before rail-roads were thought of as a means of travelling. How would the contrast appear, if, as the rate now commonly is on the Liverpool and Manchester rail-road, the journey of three fatiguing days could be abridged to three easy hours; and, in all probability, as it will be in the lapse of a few years, to less than two hours? How much stranger still, if the old lady, living a few years longer, should have to write, which doubtless she may, "that she rose from her breakfast in Edinburgh at eight, and after a delightful journey, sat down to her dinner in London at six the same evening!"

Rail-roads are indeed introducing a new era into civilized Europe, of which it is impossible to foresee the results or anticipate the advantages. Our very language begins already to be affected. Men talk of "getting up their steam" whenever they want to make some great effort or exertion; and when their tongues outstrip truth, they are said to be "going it, or rattling along at a railway speed." The "Lion of the day" will ere long give place to the "Loco-motive of the day." Distances, which used to be reckoned in miles, are now likely to be reckoned in hours and minutes; and a merchant who lives some thirty miles out of London, will tell you that he lives an hour from the Exchange. Conversely, tales and stories, which were wont to be measured by the time they occupied in telling, will very shortly be denominated by the distance between the points of beginning and end; so that we shall probably have a young lady telling her mamma of a delightful tale she listened to 120 miles long. Our Twopeny Post, as we call it, may be expected to reach to every corner of the kingdom; and in a few years, the first, second, &c. deliveries of London letters will be as punctual at Liverpool as they are now at Brentford. A Cockney sportsman, who heretofore could hardly attend a hunt twelve miles out of town, will presently put his horse and himself on a train, follow the hounds in Norfolk or Yorkshire, and recount the adventures of the chase—the hard run he had had of some five minutes long—the tremendous leaps he had taken over ditches he barely looked at, and gates he had prudently opened—with his numerous hair-breadth escapes for want of being better fastened to the saddle—to his wondering friends in St. James's or Regent-street the same evening. Nay, at such a railway rate does improvement bid fair to

progress, that I expect to hear the dame of some Devonshire squire ordering John, her coachman, to get the carriage ready the next morning, as after breakfast she intends to visit her milliner in Bond-street, take a drive round the Park, and return with a friend to dine at her house at Tiverton.

"Sed nunc amoto quæramus seria ludo."

It is an axiom in commerce, almost as self-evident as the axioms of Euclid, that the more rapid and the greater the facilities of communication between distant towns, the greater the benefit to both; and that one town cannot benefit by an improved communication without the other deriving a proportionate advantage. But to form anything like an adequate idea of the value of rail-roads to towns, one should visit Liverpool and Manchester. The immense quantities of goods of all sorts, and the vast numbers of persons, animals, &c., which are almost hourly transported from one town to the other, and to other towns near the line of the railway; together with the rapidity, economy, and comfort with which they are conveyed, could be but imperfectly portrayed upon paper. Merchants, professional men of all kinds, tradesmen, and visitors, express themselves with the most animated warmth in favour of the advantages and conveniences of the railway. Though this is not the place in which I intend to discuss the advantages of rail roads to particular trades, professions, &c.—because I hope hereafter to be able to do it more justice—yet I cannot help relating the following fact as singularly demonstrative of the extraordinary power, if I may so call it, of rail roads in facilitating commerce. A gentleman left Manchester in the morning, went to Liverpool, 30 miles off, purchased and took back with him to Manchester on the rail road 150 tons of cotton. This he immediately disposed of, and the article being liked, an offer was made to take another such quantity. Off he starts again, and actually that evening delivered the second 150 tons, having travelled 120 miles in four separate journeys, and bought, sold, and delivered 30 miles off at two distinct, consecutive deliveries, 300 tons of goods in about 12 hours! We simply ask the opponents of railways, with their darling "things as they are," could they do so? We may indeed truly say, that if the excellence of our common roads has been the body, good, well constructed rail-roads will be the soul of our national prosperity.

There is, however, one thing which I think might be improved, or rather, should not exist, at the Liverpool terminus. I allude to the short tunnel, about 290 yards long. Up this tunnel the train, at its arrival, gropes in darkness at a rate which makes a miserable contrast with the flying velocity of the preceding part of the journey, while the old-fashioned *too-too* of the horn of the guard recalls to one's mind the days when our forefathers crept

slowly through their narrow and dangerous lanes, with horns and bells, incessantly announcing to opposite travellers their approach, lest they should meet, and block each other up at impassable parts.

In pointing out anything I consider a defect, or as capable of improvement, in the Liverpool and Manchester Railway, I trust I shall not, even in thought, be numbered among its opponents. Sensible of the vast obligations which the spirited projectors of this road have conferred in the way of example on England, and being able myself to bear unqualified testimony to the readiness which animates all the members of the establishment with whom I have come in contact, to lay every thing open to scientific inquiry, I should be exceedingly sorry could any observations of mine be construed as offensive, or tend to undervalue the executive merits of this truly magnificent work. That there are defects in a work which is the first of its kind, every one must suppose; and it is no small credit to the constructors, that they are so few, and not more important.

Every one who has seen the starting of a well-horsed stage coach, has doubtless felt the sensation it produces. The proud impatient pawing of the horses, and the melodious notes of the bugle, give an air of imposing grandeur to our departing friends, which, in spite of ourselves, makes us long to be the partners of their journey, and has doubtless produced more travellers than the most vivid descriptions could do. Again with the steam boats, what immense numbers used to congregate to witness the sailing of these vessels from Cumberland Basin at Bristol; of which the band of music certainly formed not the least part of the attraction! Can we suppose that the proprietors were not fully aware of the effects of the music on the visitors, and as a consequence, on their own pockets? It is not enough in the present day for a measure to be useful: it should likewise be agreeable and attractive. Who would eat a hare without sauce? He who indeed expects to reap the greatest quantity of benefit from the public, must not only gratify their wants and their wishes, but their very whims. It is on this principle that I wish to see some improvement in the departure of our railway trains. Rather than I would hear the customers of a great and opulent Company called together, and told to prepare for departing, as it is at Liverpool and Manchester, by the tinkling of a bell which would disgrace the dinner-call of a fifth-rate workshop, I would get, if nothing better was to be had, a few fractions of notes from some old broken-winded cavalry trumpeter. It is to be hoped the Greenwich, Birmingham, and other Companies now forming, will manage matters betters.

Moreover, I should like to see some little improvement in the appearance of the road. In many places the ballasting and dirt are almost on a level with the edge of the rails, while in others the naked blocks and sleepers

present a terrifying aspect, threatening inevitable destruction to engines, carriages, and passengers, should the train by any accident run off the rails. Indeed the toute ensemble looks like some half-finished work, reflecting the features, not of a rich and flourishing company, but of abject pitiable poverty. Surely this cannot be needful; at least it is very different on those portions of the Birmingham and Greenwich lines that I have seen. There every thing looks finished and well done, as if wealth presided, and skill directed the operations. Why is it not so on the others?

So also, if a little more intimacy was encouraged between some of the men's faces and soap and water, it would not be amiss. It is true their business is dirty, but many of them looked to me as if they were of the genus of sweep chimneys, who, I have heard, wash seldom oftener than once a year. For my part I shall never forget the impression made on me once, when ascending the Whiston inclined plane. I was outside the carriage last before the mail, with my back towards the engine, and noting down the time of our passing the quarter mile posts. We shot by the station of the auxiliary engine, a dirty-looking place at the foot of the plane, with great velocity, and before we had ascended half a mile, our speed had diminished nearly three-fourths. The former engine now slowly moved into our track, and then pursued us with the swiftness of an arrow. Here the effect began. The red-hot cinders every now and then dropping from the grate, and the immense volume of steam issuing from the chimney, together with the black faces of the men, and the flying velocity of their engine, I could not help observing to the guard that attended me, looked as if his Satanic Majesty had just sent out two of his imps with the instrument of torture, vomiting forth fire and smoke, to bring back some spirits escaped from his grasp; to which the deep grunting of our own engine, now distinctly audible from our slow motion, seemed to typify the moans of despair, and of anticipated torture.

These are observations which some may think too trifling for such an important subject. It may be so; but I confess I am one of those individuals who do not despise attention to little things in great matters, and particularly to the articles of neatness and cleanliness; for I perfectly agree with Virgil, that

"Virtue is never so agreeable as when it comes in a pleasing form."

THE EFFECT OF RAIL ROADS ON THE PROSPECTS OF THE IRON TRADE.

To the Editor of the "Railway Magazine, &c."

Sir,

The great advance which has taken place in the price of iron within the last few months, has led many persons to ask whether this is in consequence of the increased demand which the introduction of rail roads has caused for that article. Although is is probable that that is not the sole cause, it may very fairly be considered as the principal one; for although there is certainly an increased export of manufactured iron, it is not sufficient to warrant an advance of 85 per cent. in the price, which is the increase since June last.

The total quantity of iron smelted in England and Wales in 1827, when the make was probably at its maximum, was 690,000 tons. Now it has been stated that there are 1,500 miles of rail roads in this country, either actually in progress, or presenting real grounds to imagine they will shortly be so. This length of road will require 450,000 tons of iron at the usual rate of 300 tons per mile. If to this we add as much more for foreign demand, which is probably very much below the mark, as the actual orders in this country from abroad already bear a large proportion to this amount, and which of course is independent of all new lines of road not yet ready for the rails; we shall soon see that it will require a very long time before even the present demand can be supplied. Supposing that the whole of this quantity were not required for five years, that would give 180,000 tons per annum, or 26 per cent. on the total make, to be supplied to an entirely new branch of trade. As long as this extensive demand continues, we need not expect to see iron again sold at a low price, notwithstanding the assertion of some persons "that the present high price cannot last." Like the man who always predicted a rainy day, these shrewd observers will be right at last,—if they live long enough.

The immense importance of the iron trade of this country, both, as one of the great staple commodities of its commerce, and also from its being necessary for the completion of those great undertakings, the rail roads, which bid fair to alter our whole social and commercial relations, by the facility of transport which they afford, renders a retrospective view of it for a few years past, particularly interesting at this time. In the year 1740, the total quantity of iron made in this country was only 17,000 tons; and 44 years

after that, the make had only reached to 68,000 tons; from that period the increase appears to have been gradual, until at last we see it arrived at its present importance.

From statistical inquiries which have been made, it appears probable that there are not less than 90,000 persons actually employed in the manufacture of this article in England and Wales; and if we add to this the wives and children dependent on the labour of the men, we shall find there are not less than half a million of persons deriving subsistence from this branch of trade; and this, being only the production of the raw material, is wholly independent of the immensely greater number who are employed in converting this to every variety of useful and ornamental purpose to which iron can be applied.

Prior to the latter end of the last century, scarcely any but cast iron was made in this country. The quality of the bar iron being so bad, that foreign iron was almost universally used. So complete a change, however, has taken place in this respect, that it may almost be said that foreign iron is not used at all in this country at the present time, except for the making of steel; foreign iron being made with charcoal instead of coke, rendering it more suitable for this purpose. Yours, &c.

London, 20th February, 1836. C. H.

ON THE RIGHT OF PROPERTY IN, AND PIRACY OF, RAILWAY PROJECTIONS.—By the Editor.*

In a state of society so constituted as ours now is, property is a term of a most general and comprehensive signification. There was a time when the word property was solely confined to signify lands, goods, and chattels; in short, something tangible and ponderous. But this limitation has long since passed away, and the offspring of the mind is now as much a man's property as his houses and lands are; he is even liable to be taxed to the relief of the poor for the produce of it. It is true, in common parlance, when we call such a one a man of property, we immediately understand that he is possessed of extensive lands, considerable money in the funds, or a large stock and floating capital in trade. We never certainly designate a man of great intellectual attainments or knowledge a man of property; yet, curiously enough, men claim a property in ideas, and law has sanctioned the claim. If a person hear and publish the sentiments of another for his

* In consequence of the present interest in the subject, and of certain matters likely to come before the public, the Editor conceives it needful to reprint with some corrections this article which he published in another work some months ago.

own profit, though he had paid for the information and had heard it in common with hundreds, so jealous is the law of the author's rights, that the publisher is amenable for the publication as for a theft, unless there had been a special or implied permission to publish. This point has been settled in the celebrated case of Abernethy and the *Lancet*.* Property, indeed, is now a term so very comprehensive, that it includes every thing corporeal or incorporeal which can be turned any how whatever to advantage or profit.

As fast as a new species of property arises, statutes for its protection, as they are called, are framed; but it would be much better to leave it to the protection of the common law. Thus, in literary property, what have the statutes done?—abridged the author's right from perpetuity to twenty-eight years. Have they not by this means plundered his posterity of an inheritance probably of the utmost value, which may have cost him half as long again in the labour of composition as the time allowed for his proprietary right? A man shall devote a long life to the perfection of some object which shall be an honour and ornament to his country, in which the whole human species may derive a perpetual and incalculable benefit, yet he, the author of all, is in this way, by legislative wisdom, clipped of his just reward and that equitable property in his works, which the common law would have given and secured to him. Is this, I would ask, encouragement? Is it even equity or honesty? We are told, "the common law is the perfection of reason, whose object and end are justice in the most comprehensive sense." Surely here, statute law is the perversion of reason, whose object and end are injustice on the most incomprehensible grounds.

Public interest having now been found to be deeply connected with railways, projectors, like mushrooms, have sprung up in every possible direction. Being objects of considerable profit, they are sought after with avidity. Never did phrenologist more sedulously explore the bumps and cavities of a thief or a sage's skull, than railway schemers do now the knobs and valleys of old mother Earth's surface. Smitten, I presume, with the "*amor nummi*," even some lawyers have left their Coke and their Lyttleton to turn railway projectors, or railway company concocters; but of this more by-and-bye.

Probably it is not of much consequence who plans and executes railways, provided there is some regard paid to honour and honesty; for the difficulties in the executive part are rarely of an elevated character. It is, however, quite necessary to check the effrontery with which some invade the

* An injunction was obtained, but from circumstances connected with Mr. Abernethy's professional situation, Mr. Wakely, Editor of the *Lancet*, has since informed the writer it was afterwards dissolved.

rights of others. They think, or pretend to think, because there is no statute for it, that projectors have no protection, and that every daring knave, who, by unblushing impudence and falsehood, can get together a company, may play the rook on the invention of his neighbour. This is particularly the case with a few who affect to appear before the world as the more respectable portion of the engineering profession.

It is with the view of shewing these railway purloiners that they have no such privilege of self-appropriation, and cannot make these thefts with impunity, that I now call public attention to the subject, and I trust it will not be in vain. At least, I hope it will excite some one, within the circle of whose pursuits it more immediately falls, to take the matter up, and to shew the public in befitting terms the gross illegality as well as injustice of such conduct. If my observations have this effect, the end will be answered and justice will be done. Men of honourable minds will see that they cannot support such schemes without contaminating their own fair characters, and will consequently find it needful to shrink from such unprincipled plunderers, as they would from the contact of some foul fiend or midnight burglar.

Perhaps we shall not lose our labour if we examine the grounds on which these *gentlemen* defend their invasions. "Every individual," say they, "has an equal right to project a railway, and the whole country is as much open to one as to another. Consequently it follows, that A, B, C, to the end of the alphabet, have severally a common independent right to projection and execution, and there being no Act to give a preference, any one or a dozen may design the same line and get as many companies as they can." Now this reasoning is exceedingly specious, but exceedingly false. We grant that the right of projection is, in the first instance, open to all. We grant also, that there is no statute law on the subject, and that no one has any preferable right. We will go farther: we will admit that a dozen, or a hundred if they please, may survey the same line, publish the same plan and section, and form as many companies; but then they must be independent, coexistent, and simultaneous. If any one makes his surveys and publishes his plan before another, and at the same time is progressing with a company, that man has a prior proprietary right, by the common law of the land, which cannot be wrested from him or invaded. "When a man," says Sir William Blackstone, speaking of literary labours, "by the exertion of his rational powers has produced an original work, he seems to have clearly a right to dispose of that individual work as he pleases; and any attempt to vary the disposition he has made of it, appears to be an invasion of his right." If this be true in literary works, which commonly require only the exertion of the mental faculties, how much more so is it in railway designs,

which not merely require mental but great bodily exertion, and considerable expense into the bargain? The truth is, no man who has a single idea of law or justice would attempt to question it, and certainly no one who is not lost to every sense of honour and honesty would think of trying it. But some engineers, it would seem, and lawyers too, are not overloaded with honour or honesty. Possibly these terms are not in their vocabulary, or they may have in their creed an additional or eleventh commandment, which they better understand and more devoutly observe—"Take care, first of all things, of thyself; keep what thou hast, and catch what thou canst."

Bracton informs us that the common law is "universally comprehensive," excluding no kind of property whatever; and the boasted axiom of it is, that "it provides a remedy for every injury." Will any one then say that to invade the line a man has laid down and surveyed for a railway, at great labour and cost, and to endeavour to take it from him, and of course to deprive him of that fair credit and remuneration to which he is entitled, and which he may reasonably expect for his pains and expense, is not a remediable injury within the strictest sense of the word? But these railway rooks will tell you, that they have surveyed the same line, and have been at equal or greater expense than the man they oppose. True, but who gave the first idea; who made the first survey; who first published his plans? This is the man in whom the right of property is vested, if he is still occupied with the same line and has not abandoned it for another. If others have gone over the same track subsequently, knowing what he had done, and that he is still in the field, their loss must be their reward for their want of honour and manly feeling.

As to the absence of statute law on railways, they are notoriously a new subject altogether, which, happily for projectors, is not yet ripe enough for legislative interference. But that railway designs are not, therefore, without the pale of the common law, hear what Mr. Justice Willes says. "The principles of private justice, moral fitness, and public convenience," observes this learned judge, "when applied to a NEW SUBJECT, make common law without a PRECEDENT." What can be more apposite, or more conclusive? Though there is no statute law, these things are, notwithstanding, obviously within the rigid cognizance of the common law. Where else would be the "perfection of reason" which the common law assumes to be, if it afforded no protection to invention and bodily labour? Where would be the justice it professes to have for its end and object, if after a man had exhausted his mind and his means on any subject—ay, and for public convenience too—it leaves him to be robbed of his reward by every graceless knave who has the audacity to try and the strength to do it?

To avoid the stigma of taking the identical line, some have recourse to a

stratagem which, in my opinion, is more disgraceful than a direct piracy of the line itself. They take the main features of the line, and deviate here and there where it is of no consequence; and then, with all imaginable modesty, call it a new line. For instance, if it is a level open country, they will sweep off a little to the right or the left, and come in again at the grand points. If a hillock intervenes they will go round one side, the original projector having gone round the other, never heeding a few feet of embankment and cutting. If the first line runs along one side of a river they will carefully take the other, feeling it delicate to encroach on the man they intend to ruin. But, wherever a town, or important village lies, or the country presents a difficulty, there their delicacy vanishes, and plump they fall into the track of the man they do not like to encroach on. So very prettily indeed do they sometimes manage it, that if the two lines were laid down on a map, it would be difficult to distinguish the piratical from the true line, unless by its graceful sinuosities about the latter. What, however, does this amount to but a colourable alteration, a paltry subterfuge, a cowardly effort to hide a theft the man is conscious of, but wants impudence or courage to defend? Give me, if I must choose, him who boldly seizes the whole. If he robs, he robs openly; but the other, like a sneaking assassin, waits his opportunity to stab that he may plunder securely. Cunning is here, however, of no avail. The law acts on a broad basis, and will protect the original plans from any colourable alteration, as much as it will from direct theft. If not, who would be safe? Between the chief points there may be several courses equally good, out of which the engineer chooses one, for he cannot have all. So, with a hill, or a river in the direction of his line, he must go on one side, he cannot go on both sides. The merit of design lies not in these minutiæ, but in the grand points taken as a whole. Would it then, for a moment, be entertained that preserving these great points, and selecting one of the unimportant, which the projector had necessarily rejected, constitute originality? The Court of Chancery would soon tell him, who might have the hardihood to try it, a different tale.

As it is obvious that two engineers may fairly and *bona fide* project lines between two towns, either at the same or different times; it may be asked, what is the test for piracy, and to what distance must one deviate from the other to escape the charge? This will depend how far the two terminus towns are apart. If they are far asunder, it may generally be assumed, that when two lines are so projected as closely to embrace the same intermediate towns, the one is a piracy of the other, otherwise not.

I have once or twice been asked, "if a man has projected a railroad and cannot proceed with it, is he to hold that line interminably to the exclusion of others, and the prevention of the country from having a railroad?"

Surely not; but a fair time must be allowed him to try his strength. He is not to be jostled out of his right, because he cannot *per saltum* get a company; nor is his chance of success to be thwarted by slander, intrigue, or dastardly machinations. If he is so treated, let him lay his case fairly before the public, and I am confident the general high character of gentlemen who support these schemes will not be appealed to in vain, nor will the authors of such conduct fail to receive their just reward.

While I am on this subject I ought, perhaps, to notice the unfairness with which some engineers decry rival lines. But this is a course so pitiful and mean as usually to receive—and it is to be hoped will always insure—the full meed of unqualified contempt and immeasurable scorn.

I have only to add, that conscious of my inability to do justice to the subject of this letter, I have undertaken it merely to break the ice for others, and with the hope too, that it may induce some gentlemen to look carefully into the merits, as to originality, of the lines they are supporting, so as not to be deluded by individuals, who care but little for others, or for the character, or indeed for the success of the measure, so long as it tells well for themselves.

ON THE PHILOSOPHICAL PRINCIPLES OF HEAT, APPLIED TO DOMESTIC PURPOSES.

TO JOHN HERAPATH, ESQ., THE EDITOR OF THE "RAILWAY MAGAZINE AND ANNALS OF SCIENCE."

SIR,

OWING to recent accidents which have occurred from the improper erection of apparatus intended for warming buildings, I have been led to investigate the subject of artificial heat as applied to domestic purposes; and I find that many of the inventions at present in use, are so utterly at variance with all the principles of sound philosophy, that I am induced to send you the result of my inquiries, as I think the subject has not attracted the attention it deserves; involving, as it does, the comfort, health, and safety of so many individuals. My observations are not addressed to the scientific; but are intended to point out in a popular manner those errors which may be avoided, and are only indured from ignorance, alike of their cause and the possibility of their removal.

Philosophy is, perhaps, never more usefully employed than when assisting in the practical application of the useful arts. The theories which it frames

are so useful to the proper application of practical knowledge, so valuable in correcting the errors which inevitably arise, and so often impede the labours of the practical operator in the arts, that we cannot wonder, when the qualities of theoretical knowledge and practical experience are united in the same person, that valuable results are obtained. The greatest discoveries in the arts and sciences—those distinctive features which mark civilised man from his prototype, the uninstructed savage—have nearly all been made by practical men, enlightened by the study of philosophy; and it is they who discover in a phenomenon, which to ordinary minds presents nothing worthy of observation, a germ which struggles, instinct with life, to bud forth and spread its luxuriance far and wide. The same phenomena which suggested to Volta the discovery which bears his name, and has produced such a revolution in chemical science, or led Watt to speculate on and improve the steam engine, would probably in other minds have passed unnoticed, and most likely had, in fact, been before observed by others without any thing more than a passing thought. Not so the experimental philosopher: there is no operation of nature, however insignificant it may appear, which is not capable of calling into action the powers of thought and reflection; and if it does not add to his usefulness, it will at least increase his pleasures by enabling him to exercise that attribute which is man's distinguishing feature—reflection.

These ideas suggest themselves when reflecting on the present imperfect systems for obtaining artificial heat for domestic purposes, many of which possess defects so glaring, that were they rightly understood they could not maintain their ground in the public estimation even for a single day. I do not mean to affirm that all these inventions are devoid of ingenuity; but I consider that no invention *for this purpose* deserves to be called philosophical, unless it ministers to the health, comfort, and safety of those who employ it. If saving a bushel of coals at the sacrifice of health, or blowing down a house by high pressure steam, to avoid some fancied inconvenience from other methods, be the test of philosophy, then, certainly, some of the present contrivances for warming are eminently philosophic; but if other tests are applied, they may, perhaps, when weighed in the balance, be found wanting.

The present methods of warming buildings may be divided into three classes: first, the common open fire places and stoves; secondly, hot air stoves and flues; and, lastly, steam pipes and vessels, in which a heated fluid is made the medium for diffusing warmth. Of the first of these, it is unnecessary to say anything; the open fires are so congenial to our notions of comfort, and so unproductive of harm, except from accidental carelessness, that they will exist as long as "an Englishman's fire side" is synony-

mous with comfort and happiness; but to hot air stoves the objections are both numerous and extensive.

The principles of all hot air stoves are the same. The air is made to pass over a surface of hot air, which frequently in large stoves is heated to redness; and becoming lighter as it becomes hotter, it passes off to allow a fresh supply to take its place, which likewise in turn makes way for a further quantity. That this plan affords much heat is certain; but whether this heat is a natural and wholesome heat we will now inquire.

In all the analyses of atmospheric air which have been made, the relative quantities of all its constituents are found to be invariably the same, with the exception of water, which exists in it in the state of vapour, to the extent of about one and a half per cent. on an average. That the salubrity or insalubrity of any particular place is greatly influenced by this variable quantity of moisture, is an opinion held by some of our first medical jurists; and whatever, therefore, unduly alters the usual and necessary quantity, is injurious to health. Water is a solvent of animal and vegetable matter, and when from marshy grounds an excessive quantity of moisture is exhaled, extraneous gases are received along with it by the atmosphere, arising from the decomposition of the animal and vegetable matter; and malaria is produced, bringing its train of evils. This is likewise much heightened by the circumstance that air saturated with moisture is incapable of carrying off the quantity of insensible perspiration from the body, and of pulmonary transpiration from the lungs. The quantity of fluid which the human body requires to rid itself of to retain a healthy action, is very inadequately comprehended by many persons. By Thenard's experiments on the perspiration from the human body, it appears that the minimum quantity is 9 grains, and the maximum 26⅔ grains *per minute;* if the ordinary quantity be considered as 12 grains *per minute*, there will be given off in perspiration only, 3 pounds, troy weight, every 24 hours from a healthy man. In addition to this apparently large amount, there is a further quantity of moisture given off in pulmonary transpiration; this amounts, according to Sanctorius, to 8 ounces in 24 hours. Mr. Abernethy makes it 9 ounces, and Dr. Hales 20 ounces in the 24 hours. Mr. Abernethy's calculation is just 3 grains *per minute*, which is 3-4ths of a pound, troy weight, in 24 hours.

As air will only absorb a definite quantity of moisture, we see what injury must result from living in an atmosphere already saturated, and which is therefore incapable of carrying off the proper quantity of moisture from the human body; and the converse of this position is likewise true, for air which has had its proper proportion of moisture lessened by artificial means, absorbs it again most greedily from whatever contains it; and, therefore, the human body, under these circumstances, is called on to yield more than is

consistent with health. The higher the temperature of the air, the greater is its capacity of absorbing vapour; and, therefore, air when heated acts, to a certain extent, as though it had been artificially dried. Thus, a cubic foot of air at 54° contains 4 grains of water, and at 57° it contains 6 grains of water, so that at the latter temperature the air in a room 12 feet square and 9 feet high, will contain 1 pound 4 ounces of water, troy weight. Now, suppose such a room to be heated by a hot air stove: we know that water is decomposed by hot iron, and even by iron at every temperature when in its natural state, but the higher its temperature the greater its decomposing power in a greatly increased ratio. The water contained in the air, then, is decomposed by passing over the heated surface of the stove, and being rendered too dry, will absorb moisture from the human body and lungs too rapidly. But in addition to this, the chemical qualities of the other constituents of the atmosphere are altered by the great heat of the stove; for oxygen, which is the vital part of the air, appears to undergo a change when exposed to any heat which is much above 212°, the boiling point of water. This is rendered apparent by the disagreeable smell which arises, not only from these stoves, but likewise in rooms heated by flues, where the fire not being in the room cannot cause the effect, and it probably arises from the oxygen undergoing some chemical change;* perhaps, also, some portion of this unwholesomeness may be due to an escape of sulphureted hydrogen gas through the brick flues, which is given off in the combustion of coal, and is of an extremely subtile nature. I certainly consider that a part of the smell from hot air stoves is caused by this gas, which is the most unwholesome with which we are acquainted; in so much, that it has been proved that a dog is destroyed in air which contains $\frac{1}{800}$, and a horse will die when the air contains $\frac{1}{250}$ part of its bulk of this gas. Perhaps, also, to sulphuret of carbon may be due some portion of the disagreeable smell from these stoves, for both these gases are generated during the combustion of coal, and not having so free an escape as in the common fire-places, a portion of them will become mixed with the air in the room. The same objections lie against the use of flues as against hot air stoves, as the heat of that part of the flue nearest the fire is frequently very great: could the temperature be kept under 240° or 250°, it would probably be innocuous; but this cannot be

* A proof of this is afforded in the working of a patent invention for blowing the furnaces used in smelting iron. Instead of blowing in the cold air in the usual way, it is made to pass through an iron chamber heated to about 300° of Farenheit: nothing whatever besides this is done, and yet the iron made in this way is found to be completely of a different quality, being much more brittle. This can only arise from some chemical change which the air has undergone in the process of being heated.

accomplished. Improvements have been made in hot air stoves by having the radiating surface very much larger in size, and the same quantity of fire being employed, the temperature of the radiator is therefore much lower; but this merely mitigates the evil without removing it: the error lies in the *principle*. Any one who has stood for a few moments over the ventilator which carries the heated air from a hot air stove into a room, must have experienced the intolerable sense of suffocation which it produces, arising from the causes here pointed out, and which only becomes less intolerable at a distance, because their deleterious influence is more diffused.

A new kind of hot-air stove, known by the name of the Gas Stove, presents some singular exceptions to these observations, as, from being heated in a different manner, some of the effects are the reverse of those we have been considering. The stove is a shell, or case of iron, in the inside of which is a circular ring pierced with a number of holes, and communicating with the gas pipe in the street. The carbureted hydrogen, or coal gas, issuing through these holes, affords, when ignited, a very considerable heat, which is absorbed by the iron case, and given off by radiation to the air in the room. The combustion of this gas is supported solely at the expense of the oxygen, or vital air, which is abstracted from the atmosphere, and the heat emitted is in proportion to the quantity of oxygen consumed. A stove of this kind, of the usual size, burns about eight cubic feet, or 13,824 cubic inches of coal gas *per hour*, which will require 27,648 cubic inches of oxygen per hour, to be abstracted from the atmosphere for its combustion. As it is a principle now abundantly recognized, that, whatever are the changes of form to which matter is subject, nothing whatever is lost; let us inquire what becomes of this large quantity of gaseous matter, and what the effects arising from its change of state.

Carbureted hydrogen gas contains in every 100 cubic inches,

	grs.
200 cubic inches of hydrogen, weighing	4·26
100 cubic inches of gaseous carbon	12·69
	16·95

condensed into 100 cubic inches; the weight of which is therefore $16\frac{95}{100}$ grains per 100 cubic inches. During the combustion of this gas, one half the oxygen consumed unites with the *hydrogen*, and forms water; the other half unites with the *carbon*, and forms carbonic acid gas. In the above mentioned 13,824 cubic inches of carbureted hydrogen, which is the horary consumption of the stove, there are 27,648 cubic inches of hydrogen, which will unite with 13,824 cubic inches of oxygen, and form 20·88 cubic

inches of water, weighing eleven ounces troy weight: for as *one cubic inch* of water when decomposed, yields

		grs.
1,325	cubic inches of hydrogen, weighing	28·06
662	cubic inches of oxygen, weighing	224·46
1,987		252·52

we at once find, as 1,987 cubic inches of these mixed gases give *one cubic inch* of water; 41,472 cubic inches of the gases mixed in the same proportions, (being the hydrogen and oxygen consumed, per hour,) will give 20·88 cubic inches of water, which at 252½ grains *per inch*, makes the weight above stated. The quantity of carbonic acid produced, is exactly equal in bulk to the total quantity of the carbureted hydrogen used; and therefore, supposing such a stove as above described to burn fifteen hours a day, there will be formed 13 pounds 9 ounces, or nearly a gallon and a quarter of water; and 207,360 cubic inches of carbonic acid gas, *per diem.*

Unless the quantity of pure atmospheric air be such as to afford an ample supply of oxygen, a portion of the gaseous carbon will escape unburned, and will then be given off in the form of an impalpable powder, having the appearance of smoke on the ceiling and walls of the room, and will also be inhaled by the persons breathing this contaminated atmosphere, to the undoubted injury of their lungs.

From what has previously been said about the quantity of moisture given off by the human body, we must at once see that from the great quantity of water formed by these stoves, and which is exhaled in the form of vapour, the atmosphere of any room where they are used, must be incapable of receiving the due quantity of moisture from the human body: in addition to which, from the large quantity of the deleterious gas, carbonic acid, which is formed, and from the immense consumption of oxygen by these stoves, the air is not able to afford a due portion of vitality to the human frame. Whatever be the end to which oxygen is applied in the animal economy, it is certain that it, in some way, goes to repair the waste of animal power, and there is a demand for an increased quantity when there is increased muscular exertion: hence the greater number of respirations, and the laborious breathing after running or other violent exercise, and the deep drawn sighs and forced inspirations when we feel extraordinary lassitude, by all which means we obtain larger quantities of oxygen; and when we breathe an atmosphere which contains too small a per centage of this vital fluid, we feel great languor and depression. If each one of these effects be injurious by itself, they must, *in cumulo*, be highly detrimental, and the evils which arise from the use of hot-air stoves and flues, are generally much increased by imperfect ventilation. *(To be continued.)*

FALL OF TEMPERATURE IN ASCENDING THE ATMOSPHERE.—By the Editor.

It has long been known to philosophers and men of science, that the higher we ascend in the atmosphere the colder it is.

The scientific solution of the problem of the rate, however, at which the temperature sinks with regard to the ascent, is one of great difficulty, and has very much embarrassed mathematicians. To this moment it is a subject of dispute; some imagining one law of decrease, some another. Mathematicians of the highest order, though they have bent their utmost attention to it, have not been able to deduce, even from experiment, the true rate of decrease. Some years ago the subject was taken up by the editor of this magazine, as forming part of a work he was then engaged in preparing for publication; and from theory alone, with barely the specific gravities of air and mercury, unaided by any experiment, he was enabled to solve the problem—the most difficult he had then encountered in the whole range of the physical sciences. It appears from this solution, that the temperature of our atmosphere, supposed dry and in its mean state, reckoned on our thermometers, decreases uniformly at the rate of °·92Fahr., or °·511 Centigrade for every hundred yards of altitude. Following this law, the subsequent table of depressions, extracted from a much more extensive table computed for the work before alluded to, will easily enable the reader to determine the average decrease of temperature at any altitude:—

Altitude, Yards.	Decrease of Temperature.		Altitude, Yards.	Decrease of Temperature.	
	Fahr.	Centigrade.		Fahr.	Centigrade.
	°	°		°	°
10	·092	·051	100	·920	·51
20	·184	·102	200	1·840	1·02
30	·276	·153	300	2·760	1·53
40	·368	·204	400	3·680	2.04
50	·460	·256	500	4·600	2·56
60	·552	·307	600	5·520	3·07
70	·644	·358	700	6·440	3·58
80	·736	·409	800	7·360	4·09
90	·828	·460	900	8·280	4·60
100	·920	·511	1000	9·200	5·11

In the subjoined table I have compared the theory with the collection of celebrated experiments by M. Ramond; and the insignificance of the mean error in 42 experiments, made under nearly every variety of clime and circumstances, from altitudes of 300 to 7630 yards, is a proof of the accuracy of the law, and consequently of the confidence which may be placed in the above table.

Names of			Temperatures Centigrade.					
					Differences		Errors.	
Higher Stations.	Lower Stations.	Altitudes in English Yards.	Lower Station.	Higher Station.	Observation.	Computation.	Particular.	Mean.
			°	°	°	°	°	°
GuyLussac's Ascent . .	Paris	7630	30·8	– 9·5	40·3	39·0	–1·3	–1·3
Chimborazo .	South Sea	6427	25·3	– 1·6	26·9	32·8	+5·9	+5·9
Mont Blanc .	Geneva, Noon . . .	4782	28·3	– 2·9	31·2	24·4	–6·8	–5·8
	2 hours, P.M.	. .	27·6	– 1·6	29·2	. .	–4·8	
Pic de Teneriffe	Orotava, (by Cordier) .	4077	24·9	+ 8·4	16·5	20·8	+4·3	+4·3
Mont Blanc .	Chamouny, Noon . .	4070	23·0	– 2·9	25·9	20·8	–5·1	–5·5
	2 hours, S.	. .	25·0	– 1·6	26·6	. .	–5·8	
Etna . . .	Catana, (by Saussure)	3649	23·1	+ 4·4	18·7	18·7	0·0	0·0
Mont Perdu .	Tarbes	3408	25·6	6·9	18·7	17·4	–1·3	–1·3
Col du Géant .	Genève	3346	24·9	4·5	20·4	17·1	–3·3	–3·3
Maladette . .	Tarbes (by Cordier) .	3174	20·8	3·4	17·4	16·2	–1·2	–1·2
Pic du Midi .	Tarbes, July 26, 1809 .	2858	27·5	11·6	15·9	14·6	–1·3	
	Sept. 15, —	. .	19·6	8·6	11·0	. .	+3·6	
	Sept. 4, 1803	. .	22·5	8·1	14·4	. .	+0·2	
	— 12, —	. .	23·5	10·4	13·1	. .	+1·5	
	— 23, —	. .	18·8	8·1	10·7	. .	+3·9	+1·6
	— 27, —	. .	19·1	4·0	15·1	. .	–0·5	
	— 30, —	. .	14·8	4·3	10·5	. .	+4·1	
Col du Géant .	Chamouny	2606	21·6	4·5	17·1	13·3	–3·8	–3·8
Mont Perdu .	Barèges	2354	25·0	6·9	18·1	12·0	–6·1	–6·1
Pic d'Eyré .	Tarbes	2347	21·3	11·0	10·3	12·0	+1·7	+1·7
Guanaxuato .	South Sea	2279	25·3	21·3	4·0	11·6	+7·6	+7·6
Pic de Montaigu	Tarbes	2244	14·5	3·1	11·4	11·5	+0·1	+0·1
Pic de Bergons	Tarbes	1959	19·0	13·5	5·5	10·0	+4·5	+4·5
Pic du Midi .	Barèges, Aug. 30, 1805	1808	26·7	16·4	10·3	9·2	–1·1	
	Sept. 15, —	. .	21·9	8·0	13·9	. .	–4·7	
	Aug. 15, 1809	. .	21·3	8·2	13·1	. .	–3·9	
	Sept. 23, —	. .	18·5	6·0	12·5	. .	–3·3	
	Oct. 19, —	. .	15·9	2·5	13·4	. .	–4·2	–3·3
	Sept. 11, 1810	. .	17·8	7·0	10·8	. .	–1·6	
	— 22, —	. .	18·9	5·8	13·1	. .	–3·9	
	— 28, —	. .	18·4	5·2	13·2	. .	–4·0	
Puy de Dome .	Clermont, June 25, 1806	1163	21·3	14·4	6·9	5·9	–1·0	
	Oct. 11, 1807, Noon	. .	17·8	10·8	7·0	. .	–1·1	
	1 hour, S.	. .	18·6	11·7	6·9	. .	–1·0	
	June 29, 1808	. .	24·8	15·2	9·6	. .	–3·7	–2·1
	Aug. 7, —	. .	32·9	23·4	9·4	. .	–3·5	
Mounne du Bagnère . . .	Tarbes	1039	10·3	9·6	0·7	5·3	+4·6	+4·6
Bedat du ditto	Do.	611	10·9	8·0	2·9	3·1	+0·2	+0·2
Pont du Berger	Clermont	537	0·3	– 2·9	3·2	2·7	–0·5	–0·5
La Barraque .	Do.	415	23·6	+21·8	1·8	2·1	+0·3	+0·3
Prudelle . .	Do.	314	28·3	25·0	3·3	1·6	–1·7	–1·7
							Mean error	–0°.22

It will here be seen that the rate of decrease is very small, being somewhat less than 16° Fahr. for every mile. We may, therefore, suppose that in railways it will be a matter of trifling consequence. Possibly it may; but if we consider that a single degree will be sufficient to change a damp-rail at the temperature of about 32° Fahr., into one glazed with ice, on which a train could not move, it will evidently be a matter of some consequence in the laying down of these expensive lines to avoid every chance of obstacle or injury to the free working of them, by keeping their summits as low as possible, so as to be the least affected by temperature.

Our tunnel advocates will very likely lay hold of this circumstance to argue in favour of tunnels, in the same way as some of them did some time ago of my observations on the effect of dews. But I would recommend them to be a little cautious. It is quite needful, when one enters the field of philosophical induction, to take into consideration, not the bearings of one subject only, but of all which are any how related to it. Hereafter I may enter more fully into this matter, and I shall then have to shew that deep cuttings will possess nearly all the advantages, and be free from all the disadvantages of tunnels.

EDITOR.

CONDENSED AIR ENGINES FOR RAILWAYS, &c.

OUR ingenious townsman Mr. Alexander M'Grew, has invented a mode of obtaining and applying power for the purposes of propelling cars upon railroads, and boats upon canals and rivers, which we deem of the utmost importance; and which, in our opinion, must, sooner or later, in a great measure, supersede the use of steam. The power is derived from *condensed air*, obtained and applied in a manner so cheap and simple, as to render the expense a matter of little or no consequence. We have witnessed, by the politeness of Mr. M'Grew, the practical operation of this invention, and are fully convinced of its entire success. Mr. M'Grew has exhibited his plan and practical models to several of the most distinguished engineers in the United States, all of whom concur in deeming the invention of the highest possible importance, and declare their belief that it will almost entirely supersede the use of steam. The inventor has taken out a patent.

CINCINNATI WHIG.

[We hope Mr. M'Grew will not deceive himself. If he succeed in this, it will be much more than we expect].—ED.

EXACT CALCULATION OF THE VELOCITY OF SOUND.

By the Editor.

[*This Paper was read at a Meeting of the British Scientific Association at Oxford, and afterwards at the Bristol Literary and Philosophical Institution; but the Author has declined repeated solicitations to publish it until now.*]

Except the quadrature of the circle and the solution of the irreducible case, no problem, at least of modern times, has obtained more celebrity than that which requires from theory alone, the exact determination of the velocity of sound. The obstinacy with which this problem has resisted the abilities of Newton, Euler, Lagrange, Laplace, Poisson, Ivory, &c. is sufficient to convince any one that something must be amiss in the principles assumed; for it would be difficult to believe that any analytical defect in the process of solution could escape the sagacity of such men. It is not my intention to occupy the time of the Association with discussing the methods pursued by the above distinguished philosophers; it is enough to know, notwithstanding their utmost efforts and the new hypothesis of Laplace, aided by the best of experiments, that the result of theory still differs from the quantity observed, considerably too much to be attributed to the errors of observation. If, therefore, any other and more simple view than that commonly received of the constitution of aeriform bodies can be taken, perfectly consistent with other phenomena, from which by a mere elementary process the true velocity of sound can be elicited, I trust it will not be unacceptable; particularly when the Association is informed, that it is only one out of a great variety of phenomena to which the same principles apply with the greatest facility and accuracy. Before another meeting of the Association takes place, I hope I shall have been enabled to submit to the scientific world a part at least of my labours on these subjects in a connected form, and rigidly tested by experiments.*

Newton, it is well known, proposed to philosophers to inquire whether our air, and all such bodies, do not consist of particles endued with a property of mutual repulsion, varying in force inversely as the distance, and always reaching the nearest particles, however much the air is expanded, and not extending beyond them, or at least not to the next, however much the air is compressed.

It is on this hypothesis, that philosophers have hitherto endeavoured to

* Ill health and other affairs prevented the publication.

compute the velocity of sound. I have mentioned it that they may compare it with the hypothesis—if any thing so simple can be called a hypothesis—which I shall now employ, and from which I have investigated in Thomson's Annals for May 1821; all the known laws of gaseous bodies, except one with which I was then unacquainted. It is there assumed, that air consists of a number of very small particles continually infringing on one another, and the sides of the vessel containing them, having no property but absolute hardness. The laws of collision for such bodies are demonstrated in the preceding number, exactly agreeing, as I have since found, in some of the principal points with those delivered by Huygens and Wren. However, in the present inquiry, we shall have no need to have recourse to these laws. We may keep nearer the beaten tract by considering the particles perfectly elastic, and yet not affect the legitimacy of our proceedings.

Now, if in an air so constituted, no disturbance be given to the motions of the particles, they will settle into corresponding motions throughout the whole extent of the air, and the medium will appear to enjoy a perfect repose; for the mutual collisions, if corresponding through the whole medium, are not considered a disturbance. But if the motions of any of the particles of this air be disturbed, the disturbance will affect their collisions on the adjacent particles, and hence the collisions of these on the next, and so on to the limits of the air, at the rate at which the particles propagate their motions. Should the disturbance be a violent displacement of the air, as that, for example, occasioned by the collision of the bodies, an aerial wave will be generated, which will travel from part to part of the medium, with no sensibly greater velocity than the slightest disturbance. For if we suppose the collision to give a great individual excess of motion to a sphere of particles a foot diameter, by the time it is propagated to the extremities of a sphere a hundred feet diameter, it would, if equally divided among them, amount individually to only a $\frac{1}{1,000,000}$th of its original quantity; and if distributed among the superficial particles only, to a $\frac{1}{10,000}$th of what it was. So that before it arrives to 50 feet from the origin of disturbance, that is to a $\frac{1}{22}$d part of the distance which sound passes over in a second, it would be so attenuated as to be altogether insensible. The same is likewise equally true in a tube. For since the mass of the tube is so great, compared with that of the included air, and the air instantly imparts its motion to the sides of the tube, all effect from any individual excess is destroyed, perhaps more rapidly than it would be in the open air.

Thus the uniform velocity of sound, and its equal propagation in loud and low sounds, are very obvious consequences. The intensity depends on the magnitude of the aerial wave or quantity of particles disturbed, and the

quality of sound I conceive on the nature of the disturbance, that is, on the sort of derangement given to the motions of the particles. But with this we have at present no concern; our object is to estimate the velocity of sound.

In the Annals already alluded to, I have deduced the properties of gases from general views of their motions, without descending to particulars; but in the problem we have in hand, this is not enough. We must discover such a system of motion as may subsist and satisfy the general laws of airs, and from this investigate the mean elasticity, and the mean velocity of the particles reduced to any rectilinear direction. Let us suppose, then, that a quantity of air is enclosed in a cubical vessel, whose faces are opposite to the four cardinal points, and the zenith and nadir. Now, if we suppose the particles to meet and strike in sixes simultaneously, one from each of the above six points, and that after collision they separate, each retracing its path, a medium might be composed which would continue its internal motions and existence *ad infinitum*, if not disturbed. Each particle would, on this view, constantly run forwards and backwards in the same track, meeting, at one extremity, always one set of five particles, and at the other another set of five particles.

Let N denote the number of the particles in unity space, then $\frac{1}{N^{\frac{1}{3}}}$ is the length of a particle's path in its going, and $\frac{2}{N^{\frac{1}{3}}}$ the length in its going and returning. If, therefore, V be the velocity per 1″ of a particle,

$$v : 1'' :: \frac{2}{N^{\frac{1}{3}}} : \frac{2}{v_{|}N^{\frac{1}{3}}}'',$$

the time of one entire revolution. Hence $\frac{vN^{\frac{1}{3}}}{2}$ is the number of such revolutions per second.

Again, M being the mass of a particle, vM is its momentum. But, because to conserve the motions, the particles are reflected back and made to retrace their paths, $2vM$ is the force of collision, or the intensity of a particle's direct stroke on the containing side.

Moreover, the space and number of particles being the same, the mean distance run by each and the mean number of collisions would be the same, with the same velocity, in whatever manner the particles do really perform their motions; but the intensity of collision on the side would be very different. For since the angle of incidence of any one particle may vary from 0° to 90°, the intermediate angle 45° is the mean angle in which it can strike the side. Consequently, $\frac{2vM}{\sqrt{2}}$ is the mean force of collision of a particle on the side containing the air; and if this be drawn into the number

of its revolutions in 1″, that is into $\frac{v N^{\frac{1}{3}}}{2}$, it gives $\frac{v^2 M N^{\frac{1}{3}}}{\sqrt{2}}$, the total mean force per second of a particle. This again multiplied by $N^{\frac{2}{3}}$, the number of particles which strike against unity area of the side, gives

$$\frac{v^2 M N}{\sqrt{2}} = \frac{v^2 D}{\sqrt{2}} \quad . \quad . \quad . \quad . \quad . \quad (1)$$

the mean force per second of the air in unity space against the side, D being the density of the air.

But if g be the velocity of a falling body by the force of gravity at the end of a second, and E the elasticity of the air or weight it will support, $E\,g$ will also be the total action of the air per second. Equating these two expressions, we have

$$v = \sqrt{\frac{E\,g\sqrt{2}}{D}}, \quad . \quad . \quad . \quad . \quad . \quad (2)$$

for the mean velocity of the particles, preserving to each its mean action on the containing side; or for the mean rectilinear velocity of the particles in any given direction; that is, by what we have before said, the velocity with which sound or any disturbance in the air is propagated.

Before we proceed farther, let us just glance at a curious consequence of the above theorem. I have hitherto said nothing of the nature or laws of heat. But by experiments we know that E is as $D \times (F + 448)$ in every gas, F being the Fahr. temperature. Therefore, by the preceding theorem, V^2 is as $F + 448$; that is, if the hypothesis we have assumed of the nature of air be true, the Fahr. temperature plus 448 is proportional to the square of the velocity of the particles, and, consequently, heat must consist in motion. Conversely, if heat consist in motion, the simplest, and hence, according to the laws followed by nature the true constitution of aeriform bodies, is that which we have supposed. The theory of heat which appears to me to be most consistent with phenomena, is, indeed, the Newtonian, namely, that heat is nothing but corpuscular motion; and that the quantity of heat in any body, is as the sum of all the motions of its particles; and if the body be uniformly hot, that its temperature is proportional to the motion or momentum of any one of its particles.

But to return: we have by M. Biot, $g = 9{\cdot}8088$ metres at Paris, Traité de Physique, tome ii, p. 15, or $= 9{\cdot}8088 \times 3{\cdot}28085 = 32{\cdot}18122$ English feet; and $D = \frac{E}{b\,m\,(1 + {\cdot}00375\,c)}$. Therefore, $v = \sqrt{g\,b\,m\,(1 + {\cdot}0075\,c)\,\sqrt{2}}$, b being the altitude of the barometer, m the ratio of the weight of a given volume of mercury to that of air, and C the cent. temperature. When $C = 0$ and $b = ,76$ metres, M. Biot makes $m = 10463$; therefore

$$v = \sqrt{9{\cdot}8088 \times {\cdot}76 \times 10463 \times \sqrt{2} \times (1 + {\cdot}00375\,c)} = 332{\cdot}124\sqrt{1 + {\cdot}00735\,c}$$

metres, or $= 1089.65 \sqrt{\frac{F + 448}{480}}$ English feet, ... (3)

in perfectly dry air. At the temperature of melting ice it is 1089·65 feet, while the experiments of Dr. Moll, which are considered to be the most accurate hitherto made, reduced to the same temperature and state, give 1089·74 feet, or ·09 more.

This result it will have been observed, has been obtained without any extra hypothesis of the effect of condensation, &c., on the temperature and elasticity, and by a simple direct process from the definition only of an air. Let us now compare the theorem with some of the best experiments that we have, by which a better opinion may be formed of its accuracy and accordance with nature. Captain Parry at Port Bowen, observed the velocity of sound to be 1035·96 feet per second, the temperature being −15°·31 Fahr. This is the mean of all the experiments recorded in Phil. Trans. for 1828, p. 97, except those of January 10th, in which there appears to be some error, and those of June 4th, made in a strong wind. By our theory the velocity should be 1034·6 feet, or 1·4 feet less. The French Academicians in 1738, found it to be 172·56 toises, or 1103·5 feet, at 42°·8 Fahr. (Connais. des Tems. for 1825, p. 370); by our theory, it is 1101·9, or 1·6 in defect. In the Cambridge Phil. Trans. and Phil. Mag. for June 1824, Dr. Gregory has published a set of experiments, the mean of which is 1107 feet, at 48°·62 Fahr. Our theorem gives 1108·4 feet, or 1·4 too much. These experiments are justly celebrated for their great accuracy, considering the smallness of the bases employed. The Connaisance des Tems for 1825, contains the experiments of M. Arago and colleagues; the mean of the first set, made June 21st, 1822, was 1118·4 feet, at 60°·62 Fahr; and of the second set, the next day, 1130·3 feet, the temperature being 63°·95 Fahr. At the same temperatures, we find by (3) for the velocities 1121·8 and 1125·4 feet, that is 3·4 too much, and 4·9 too little. Collecting these observations together, we have

Names of the Observers.	Temperature of Observs. Fahr.	Velocities in English feet. Observed.	Computed.	Difference of Comp.	No allowance seems to have been made for vapour in any of these experiments, except in those by Dr. Moll.
Parry	−15°31	1036·0	1034·6	−1·4	
Moll and Co.	+32·0	1089·7	1089·6	−0·1	
Academicians	42·8	1103·5	1101·9	−1·6	
Gregory	48·62	1107	1108·4	+1·4	
Arrago and Co.	60·62	1118·4	1121·8	+3·4	
	63·95	1130·3	1125·4	−4·9	

Mean difference −0·53

Thus the mean difference is half a foot in defect, much within what is due

in the last experiments to the vapour, according to Laplace, Con. des for 1825, p. 272.

As I shall have to enter more fully into this subject in my Mathematical Principles of Natural Philosophy before alluded to, I shall not trouble the Association with the ordinary consequences of (2), and the method of allowing for the influence of vapour. There are, however, one or two facts relative to the

INTENSITIES OF SOUND IN DIFFERENT AIRS,

which I can hardly pass over, lest from their not being quite so obvious, it should be supposed the present theory of airs does not apply to them. According to our views of the nature of airs, it is evident that the intensity of sound, from the same cause at the same distance, the temperature being the same, would be directly as the number of particles acted on or displaced; that is, as the number in a given space, whether the cause of sound be in the same air under different compressions, or in different airs; for since the temperatures are as the momenta of the particles, and these are supposed to be the same, the force on the tympanum of the ear will be as the number which strikes it. In the same air, at a given temperature, the intensity will therefore be as the elasticity. But in different airs by (2)

$$\text{M}^2\text{V}^2 = \frac{\text{E}\,\text{M}^2 g\sqrt{2}}{\text{D}} = \frac{\text{E}\,\text{M}\,g\sqrt{2}}{\text{N}} = \frac{\text{E}\,\text{D}\,g\sqrt{2}}{\text{N}^2} = \frac{e\,d\,g\sqrt{2}}{n^2}$$

e, d, n representing the same things in another gas, and the temperature $\text{M}\,\text{V}$ being equal to $m\,v$. If therefore $\text{E} = e$

$$\frac{\text{N}}{n} = \frac{\text{D}}{d} = \text{by (2)}\ \frac{v}{\text{V}}.$$

That is in different gases, of the same elasticity and temperature, the intensities are as the square roots of the densities or specific gravities, and inversely as the velocities with which sound is propagated. Thus the tones or intensities become measures of the velocities, when applied to different gases. But in order that the measures may hold good, it is evident that the airs must be individually homogeneous; that is, in each gas the particles must throughout be of the same size, or at least of the same mass. If the airs, or one of them, contain particles of unequal masses, the same relation between the intensities, specific gravities, and velocities, will not hold; and hence the tones or intensities furnished by the different gases, will present us with the means of looking into their internal constitution, or of deciding whether an air under examination, be homogeneous, or a mechanical mixture of heterogeneous particles.

Those who understand the experiments and researches which have been made on the pulses, tones, &c., in the various gases, for the purpose of

obtaining the velocities with which sounds are transmitted by them, will best be able to appreciate the simplicity and fertility of the above deductions.

I shall conclude this part of my subject, with a comparison of the theoretic and observed velocities of sound in different gases, deduced from the tones they produce, by M. Dulong, in the Annales de Chimie, t. 41, p. 150, from a set of the most accurate and valuable experiments which have yet appeared. Every one knows the enormous differences between theory and the results of the experiments of MM. Chladni, Van Rees, Moll, &c. on hydrogen; and that on this account, and the singular energy it manifests in the refraction of light, philosophers had made up their minds to its being endued with properties different from other bodies of its kind; in fact, that it was a body almost of a distinct species, and connected by no laws to the rest of the gaseous family. I am in hopes I shall be able to shew in the work before hinted at, that it is equally obedient to general laws in its powers of refraction.

Names of the Gases.	Specific Gravities, by Dulong.	Velocities in Metres from Tones.	Velocities in Metres from Theory.	Differences.
Air - - -	1	333	332·12	—0·9
Oxygen - -	1·1026	317·17	316·29	—0·9
Hydrogen - -	·0668	1269·5	1266·21	—3·3
Carbonic Acid -	1·524	261·6	269·03	+7·4
Ditto Oxide - -	·974	337·4	336·53	—0·9
Oxide of Azote -	1·527	261·9	268·77	+6·9
Olefiant Gas - -	·981	314·0	335·32	+21·3

We see here that the agreement is exceedingly close in four of the gases, that it is not quite so good in carbonic acid and oxide of azote, though within very reasonable limits for experiments of this nature; but that in olefiant gas it is not within 21 metres, a considerable quantity for a gas so near the specific gravity of the air. From the experiments on the cooling and refractory powers of this air, I have long thought that it is not a chemical compound or a homogeneous gas, but a mechanical mixture of two or more gases; and this discordance seems to strengthen my opinion.

EDITOR.

TO THE EDITOR OF THE "RAILWAY MAGAZINE," &c.

SIR,

It cannot but be advantageous to the public, that the points in issue between railway projectors and their opponents, and their conflicting interests, should be generally known. By the diffusion of such information, an opposition based upon fair and just grounds would be strengthened, and many an opposition, resting upon an unworthy foundation, would prove abortive.

The success of a railway, like that of any other public undertaking, depends upon the support or opposition it receives, and which is, as often as not, given or withheld, upon grounds quite foreign to the intrinsic merits of the project; the opposition, at the same time, often assuming an importance which it by no means deserves. To the proprietary of railways therefore, as well as to their opponents, such information as that which is here suggested, must be highly interesting and useful, whether with reference to the different railways before the public now in embryo, or in a state of more forward growth. In this article, however, I purpose to confine myself to the Greenwich and Gravesend Railway, and the opposition which it incurs in the Dartford district, through which it passes.

This undertaking has gained considerably in public estimation since last year, and it would seem that no other railway seeks for legislative sanction, under better auspices. I find, however, that in the adjoining parishes of Dartford and Stone, the dissents to the railway bear still a very large proportion to the assents. I find too, that a new character of opposition has arisen there, since last year, by the formation of a ship canal, from the Thames to Dartford, which the railway must necessarily cross. This canal is proposed to be constructed with a view to the admission of ships of 400 tons burthen. It is to be formed, partly by the diversion of the waters which form the back water of Dartford Creek,—a public navigable river, and the present water communication between Dartford and the Thames; thus substituting the taxed navigation of the canal, for the free navigation of the creek, upon the supposition that the greater convenience which the navigation of the canal will afford, will more than counterbalance the loss arising from payment of canal dues. The proposed capital for the canal is 65,000*l.*, and application to Parliament to carry the measure into execution has been made in the usual mode.

I therefore propose to examine these two elements of opposition; the dissents to the railway above mentioned, and the obstacle which the formation of the proposed canal must occasion.

Who are the parties dissenting? In consulting the documents deposited in the parliamentary offices, we find that they are mostly the same individuals as are assenting to the canal, including the Commissioners of Sewers; from amongst whom, the Provisional Committee of the canal is chiefly formed. Why do the same parties assent to the formation of the canal, and dissent to the formation of the railway? Is not the injury to the landowner and occupier, of the same character in both cases, though in a different degree? The abstraction and severance of the land and other consequential injury, take place in any given distance to a threefold extent in the formation of a canal, of the dimensions of that proposed at Dartford, to that which ensues upon the formation of a railway similar to the Greenwich and Gravesend Railway.

Can the Commissioners of Sewers withhold their assent to the proposed railway, upon the ground that it infringes any rights and privileges which it is their duty to protect? Is it possible the construction of the railway will injure the sewers or drainage of the levels through which it passes? The only grounds upon which either the landowners and occupiers, or the Commissioners of Sewers, could with justice withhold their assent to the proposed railway, would surely seem, by their conduct, with reference to the canal, untenable.

The landowners and occupiers by their assent to the canal, and the Commissioners of Sewers by their not merely assenting to it, but many of them becoming its Shareholders and Directors, have effectually precluded themselves from taking any objection to the railway, which it has in common with the canal; and there is no objection to the former, which will not apply with greater force to the latter. The railway will not interfere with the navigation of Dartford creek, or affect the sewerage in the least, whereas the canal is to be formed upon the basis of the total abolition of Dartford creek, and must alter the system of sewerage to a very considerable extent.

No obvious cause exists for the number of dissents to the railway in the Dartford district. Some latent cause therefore must exist, and we can only look for it in the second element of opposition, viz: in the formation of the proposed Dartford canal. Primâ facie, the only obstacle which this undertaking presents to the railway, is the difficulty of crossing it. From the sections and gradients of the railway, and which were laid down before the canal was even contemplated, no bridge can be constructed which will admit of vessels passing under it of a larger class than now navigate the creek, (never exceeding 100 tons); and consequently an almost insuperable obstacle is thus opposed to the railway. Could the Canal Company be satisfied with such a bridge as will suffice for the creek, the two schemes might coexist, and perhaps be of mutual benefit. The views of the Railway and

the Canal Directors upon this point, however, are so wide of each other, and their maintenance are too vitally important to each party for either to give way, till a contest in the Houses of Parliament (if the Canal Company obtain funds to arrive at that stage), determine it; the very ground of the substitution of the canal for the creek, being the greater facility which it would give to the progress of a much larger class of vessels to the town of Dartford, and which such a bridge as will not interfere with the navigation of the creek, would entirely arrest. The intrinsic merits of this canal scheme will here naturally come under consideration. Is it of public utility, or local advantage? It has been observed that Dartford already enjoys a water communication with the Thames, and this is nearly commensurate with the necessities of its trade. This communication, with the additional means furnished by the London and Gravesend Railway, which passes within a mile and a half of Dartford, and in connexion with which a branch from Dartford is contemplated, may fairly be urged to render the canal wholly unnecessary. Heavy goods can be conveyed by the creek, and lighter goods and passengers by the railway, at an expense which would defy competition, by the mode of communication which the canal, if effected, would afford. But the answer to the question as to utility or advantage of this scheme, is best answered by the solution of this question,—How much of the capital is subscribed, and by whom? By the list of shareholders deposited in the parliamentary offices, it is shewn that out of a capital of 64,500*l.*, the notable sum of 10,025*l.* only is subscribed; and but a very trifling portion of that sum by the inhabitants of Dartford and its vicinity, exclusive of the Committee. If the canal scheme be submitted to the same parliamentary test which the railway must undergo, what probability is there of its success? In this canal scheme, however, the latent causes of opposition and dissent may be seen.

The landowners and occupiers it is well known are generally opposed in the first instance, at least to all undertakings which cut up or destroy the soil; and on this account they must have viewed both the railway and canal as evils. The smaller evil, however, was to be preferred. The railway was viewed with greater hostility than the canal, as being a work of so much greater magnitude; and as it was urged in favour of the canal, that its formation would cause a great obstacle to the railway, of course the former obtained preference to the latter, and is in fact supported, in some degree, solely on account of its being a good mode of opposition to the railway. To this latent cause of dissent to the railway, may be added another: the Commissioners of Sewers, we have seen, are identified as members of the Canal Committee, and they are its chief shareholders. They are also proprietors of land collectively, and some of them individually

owners or occupiers of land required for the railway. Thus acting in a triple capacity, as Commissioners of Sewers, Canal Directors, and Landowners, though their interests and duties, in these several capacities, must be much at variance; is their dissent to the railway shewn independently of the opposition which, from their station and influence, as leading gentlemen of the county, they may create against it.

From these observations may be gathered the nature and character of the opposition which the Greenwich and Gravesend Railway receives in the particular district which I have mentioned. I do not know whether I shall have to advert to the subject again, but I conceive that ere another month elapses, the canal scheme will have fallen to the ground through its own weakness, and with it much of the opposition which I have laid before you.

19*th February*, 1836. VIATOR.

THE EDITOR, ON THE METHODS IN WHICH SOME RAILROADS ARE PROJECTED, COMPANIES FORMED, AND PREMIUMS GOT UP.

(No. III.)

It is with infinite satisfaction that I see our Representatives have at once come boldly forward to combat the difficulties which are besetting them, and which, if not quickly overcome, and the subject, railroads, from which they emanate, reduced into order, will involve hundreds and thousands in one common ruin. Late in last Session I called the public attention to the enormous expense, and the tricks and frauds that were had recourse to for the purpose of procuring the Parliamentary sanction; which had the effect of almost immediately getting the subject noticed in the House of Commons. I then promised to pursue the matter; but my time since has been so fully occupied with other business, that I have been obliged to neglect it altogether, and I am sorry to say the lateness of the time, in which the present journal has come under my direction, and of Mr. Thomson's motion in the House, will prevent me from saying what I intended, until the next or April number.

That some improvement in the system of communication between distant places is absolutely, indispensably necessary, and that no method promises so

fairly to afford us almost every thing we can desire in this respect as railroads, is evident from the rapid manner in which they have already spread and are now spreading over civilized Europe and America, and are extending to Asia, if not to Africa. If it is a mania, it is therefore a mania which is not confined to England, nor is it bounded by the limits of the ocean, but is like the air we breathe, common to mankind. To endeavour to resist it then would be like endeavouring to exhaust the ocean, or stop the rising and setting of the sun. No; so thoroughly are matters changed, that it is no longer the promoters of well planned railroads, but the oppenents who are become the madmen, and who will need the particular care of their friends. That railroads will go on, and must go on, is inevitable, and to try to stop them is a mark, not of wisdom, but of superlative folly.

What is wanting of the legislature is to sift the merits of the schemes proposed to the bottom; to examine strictly on what principles they are founded, and how they have been got up. I shall here just mention a case or two of the mode of projection and getting up of lines which have actually come within my own knowledge.

A needy adventurer takes it into his head that a line of railway from the town A to the town B is a matter of great public utility, because out of it he may get great private benefit. He therefore procures an Ordnance map, Brookes's or some other Gazetteer, and a Directory. On the first he sketches out a line between the two towns, prettily curving here and there between the shaded hills for the purpose of giving it an air of truth, and this he calls a survey, though neither he nor any one for him had ever been over a single foot of the country. An estimate is then made out by the known average cost of railways, making a little alteration here and there from some loose information he may have picked up. The Gazetteer, Directory, and a pot of beer to a cad or coachman, supply him with all the materials for his revenue, which fortunately never fails to be less than 15, 20, or 30 per cent. per annum, and is frequently so great that his modesty will not allow him to tell the whole. His next object is to get a secretary and solicitor. For the former he finds a young man, or a man young in experience, who, by advancing a few hundred pounds merely for current expenses, secures a substantial situation, on paper, of some five or six hundred pounds per annum. In a similar manner is the solicitor drawn in. The large profits to the shareholders and the apparent fairness of the estimates, of which he can form no idea, are the blossoms of the golden harvest he actually expects to reap from a little present risk and trouble.

A second method of getting up a line, is that of an attorney getting together a few rich clients under the assurance that he knows of an excellent rail-road project—though he has not had an inch of it surveyed, and knows

not whether it is practicable or impracticable—promising the most ample returns. Through them, he then orders some engineer devoted to his interests, to lay out a line which must be sure to pass at or near the estates of Messrs. or my Lords A. B. and C., without the slightest regard to any other interests, or whether the country is favourable or not. These gentlemen are his clients, or he has some object of interest or profit in view, and that is enough. Thus the engineer and the committee are his tools, and the solicitor, under his modest title, the absolute dictator, through whose orders the public are to be cajoled and plundered without mercy.

A third method, which is the most impudent and unprincipled of the whole, is again, that of some attorney; for attorneys are generally the prime movers in these matters.* He first wheedles, whines, and bows himself into an acquaintance with some monied men, and then informs them of a capital project that he has, for the investment of capital. Being won over, as men may with pleasing subjects, they call a meeting, and invite engineers to submit their plans, &c. under a pledge that the best will be adopted. Having thus got all the information in his power, and a clue to some good line, the cunning solicitor orders fault to be found with all the plans presented, and another engineer, more suited for his purpose, is directed to find "the best line for the company." This trick on the engineers having succeeded, with numberless addendas I have not now time to notice, the next great stroke is to get the shares to a premium. They are, of course, all appropriated to a few. One of these few sends brokers into the market to purchase such shares at whatever price they can get them, and others to sell at not less than so much. Of course the shares are at the premium almost before a single one is *bona fide* sold. At first this premium is small, lest Johnny Bull, gullible as he is, should take alarm; but the same game played day after day, up mounts the premium to an enormous height. Quotations of these extraordinary premiums, which the public suppose spring from legitimate merit, naturally create an appetite for the concern, which is so judiciously fed as to be increased rather than diminished.

In this way are some of the concerns got up, and the public most wofully plundered to fill the pockets of a few; while other concerns of real and solid merit, in which the whole of the shares are legitimately out (as the Gravesend, &c.), and therefore beyond the control of the directors, remain at a little above par.

What I have stated are not the figments of the imagination, but cases actually before, or about to be before, the legislature. Neither are they a tithe of what, if I had time, I could point out; but they are, I presume,

* I would not wish these observations to be understood as against the profession generally. There are many that I have the pleasure of knowing as honourable men as any in England.

quite sufficient to call on the Commons and Lords to act with extreme caution, and not merely as respects the goodness or badness of a line, but as respects the parties who are the actual supporters and promoters of it.

It may now very naturally be asked, if you are satisfied of all these things, what remedy would you propose for their cure, or what means for their prevention? These are subjects of extreme difficulty, and of so much importance, that I should be sorry to approach them with haste, particularly with the haste in which I am now obliged to write. However, that I have thought of them, and consulted with men whose opinions are much more valuable than mine, is true, and in the next Number I will endeavour to submit the result of our conferences to my readers, together with some observations on the method of laying out lines, which appears in general, either to be little understood, or exceedingly disregarded.

EDITOR.

RAILWAY NOTICES AND INTELLIGENCE.

Birmingham and London Railway.—Twenty-one miles of this line of the London end are expected to be opened for the public in the ensuing spring; ten more in the summer; and the whole in the summer of 1838. A loan is to be raised, and a further call of ten per cent. to be made, to meet the current expenses of the year.

Calcutta and Sauger Railway.—With so much avidity were the shares of this railway taken up by parties interested in Indian affairs, that not a single share was to be had a few days after the appropriation.

A report having been circulated that the line was carried over a swampy ground subject to deep floods, &c., the Editor of this journal was induced to make some inquiry into it, for the sake of those who may have embarked their money in the speculation. Fortunately for this purpose, he was called on last Sunday, the 14th of February, by Lieutenant F. C., who had been in India for about eight years, and said he was intimately acquainted with that part of the country, but had barely heard of the intended railway. He most decidedly negatived the report as to *deep* floods, and stated positively that though, as in many parts of England, there were occasionally floods, yet he had never known them more than from about one foot to one and a half or two feet deep. His opinion was, that if a good embankment of 12 or 14 feet high was made it would be much more than ample. And as to the profits of the concern, when finished, he said, from the tedious and dangerous navigation of the Hooghly, and the immense trade carried on with Calcutta, he conceived they could not fail to be exceedingly great.

The Greenwich Railway.—This railway has at length commenced running

for pay, though only about 2¼ miles of the middle of it, from Deptford to Bermondsey Street, have been finished. An account of the receipts from the 8th, the day on which the running commenced, to the 19th, are in the editor's possession, and shew a progressive and rapid increase. The daily average of the first week's returns was about 17*l.*; of the last nearly 31*l.* or 11,300*l.* per annum. In this calculation, Sunday's traffic, which would have been exceedingly great, is omitted because there was no running. If we consider that this is nearly 3*l.* per cent. per annum, on the capital of the whole line, and upwards of 7*l.** per cent. on that of the part actually run on; and if we call to mind that it is on the middle of the line, without any accommodation at either extremity—particularly at the London end, which is half a mile from the bridge, instead of to the foot of it, as it will be — we may form some idea of the enormous returns this railway is likely to make when completed, from its own resources alone, without any of those tributary streams, which the Editor in a former article calculated on.

We are sorry to hear, that the carriages have not been running on either of the two Sundays. What can be the reason of this? Surely there can be no scruples on that score? We cannot for a moment suppose, that the directors who keep up their police, keep men to receive tolls, and to shew the carriages, the arches, the railway, &c. for profit on a Sunday, and very properly so, can have any qualms as to allowing an inanimate machine to roll over the railing on that day, for the convenience of the Public. If they have upon any such principle forbid the running, are they not incurring a heavy responsibility with the shareholders, in thus lopping off perhaps five or ten per cent. of their legitimate income?

Since writing the above we have made inquiries, and find that the suspension of running on Sundays is owing to the want of engines, and that as soon as they are well furnished, Sunday will not form a day of exception.

Gravesend Railway.—We hear that Colonel Landmann, the engineer, was desired on Friday the 19th of February, by the Commissioners of Woods and Forests, to stake out the line he wished to take across the Park, which he did the next day. The subject will of course be taken into immediate consideration; and it is to be hoped that the obstacles which heretofore operated against the completion of this great undertaking, will now give way in the only quarter in which opposition would be effective to the march of improvement, and the necessity of the times. How, indeed, can public property be so well employed, as for works of public convenience, and public utility? Dr. Burney and others, whose opposition was very formidable, doubtless feeling convinced that individual interests should not, especially with men who

* Since then, the daily receipts have actually risen to upwards of 14 per cent. per annum.—EDITOR.

really love their country, stand opposed to the general good, have very handsomely sent in their assents. We are glad to hear that a Meeting got up on Monday last at Greenwich, for the avowed purpose of opposing this railway, was totally unsuccessful.

"For that contemplated portion of the viaduct, which it is intended shall cross the Royal Park at Greenwich, a design has been submitted for having niches at stated intervals between the massive piers which sustain it, wherein are to be placed the busts of our most celebrated by-gone admirals, leaving vacant ones for the reception of future naval heroes, whose achievements may entitle them to such eminent distinction; the whole to be surmounted in the centre by a triumphal arch, upon which is to be erected a colossal statue of his present majesty, in full naval costume. The adoption of a design thus combining utility with ornament—an undertaking which, whilst it gives an impetus to our commerce, will help to commemorate the many naval triumphs which in perilous times secured it to us; appropriately too in the immediate vicinity of the magnificent palace which a grateful country has charitably devoted to the services of its heroic veterans, is less an object of private than of *national* concern. It is to be hoped, therefore, that no impediment will be unnecessarily thrown in the way of its advancement." Indeed! we are glad to hear this from the *Herald*.

Gravesend and Dover Railway.—One of the most numerous and respectable meetings almost ever held at Maidstone, was held there on the 17th of February, at the Town Hall, for the purpose of taking into consideration the two projected lines through the county of Kent, from London to Dover. Charles Ellis, Esq., the Mayor of Maidstone, presided. A deputation from the Gravesend and Dover company attended, for the purpose of giving any information required, but no one appeared on behalf of the "South Eastern line," as it is called. After a long and animated discussion, during which, the deputation very satisfactorily answered every interrogatory, strong resolutions were passed in favour of the Gravesend and Dover, and against the South Eastern Line, with only four dissenting voices, (and scarcely more than one of them of the town), out of some hundreds assembled. In fact a stronger symptom of unqualified preference could hardly have been given, and a petition to Parliament in favour of the Gravesend line, was eagerly and numerously signed on the spot.

Grand Junction Railway.—The works are in a very forward state, and proceeding with great rapidity.

Railway from Lancashire to Glasgow.—We hear that surveys have been made with a view of connecting Liverpool and Manchester with the great manufacturing districts of Scotland, and a report on the practicability of the line will in a few days be made. So far as we have been able to learn, the proposition is to commence the line at Preston, where the North Union

Railway now terminates, and carry it through or near to Garstang, Lancaster, Kirkby Lonsdale, and Penrith, to Carlisle, where it will unite with the Newcastle and Carlisle Railway, and thence be continued to or near Greatna, Dumfries, Sanguhar, Kilmarnock, Johnston and Paisley, to Glasgow. The advantages of such a communication to Lancashire, Westmoreland, and Cumberland, would, it is said, be incalculable.

Manchester and Leeds Railway.—On Thursday week a public meeting was held in Manchester, the Boroughreeve in the chair, at which Mark Phillips, Esq. M.P. and many of the leading capitalists of the town were present, when resolutions were passed expressing a strong conviction of the advantages that would result to Manchester from a railway communication with Leeds, the capital of the woollen district, with Hull, and with all the intermediate country; and on the statement of the Directors that they were ready to go to Parliament in the ensuing session, it was resolved to petition both Houses in favour of the Bill, and a petition was passed at the meeting. There cannot be the slightest doubt but that this railway will be made, sooner or later; the advantages it presents are too great for the inhabitants of Lancashire and Yorkshire to dispense with it. Lord Stanley has consented to take charge of the Bill. Much opposition will be offered by the canal proprietors and others; and it may be doubted whether the Bill will succeed this Session, but of its ultimate success there cannot be a doubt.

Newcastle and Carlisle Railway.—Blaydon and Hepburn Railway.—A special general meeting of the proprietors of the Newcastle and Carlisle Railway is to be held at the Assembly Rooms in this town, on Thursday, the 18th of February, for the purpose of considering and deciding upon a proposal for the purchase, by the said Company, of the works, property, and effects of the Blaydon, Gateshead, and Hepburn Railway; and the transfer of the powers cf the said last-mentioned Company to the Newcastle-upon-Tyne and Carlisle Railway Company, on terms to be declared at such meeting. The Shareholders of the Blaydon and Hepburn Railway Company are to have a meeting on the subject also, at the same time and place. We are not acquainted with the circumstances which have led to this proposal; but whatever they may be, we trust the works will be carried forward with spirit, and that we shall soon see preparations for bringing the railway where it ought to have been brought long ago—namely, into the town of Newcastle.—*Tyne Mercury*, February 8.

Opposition to Railways.—The proprietors of the Ayre and Calder Navigation, and of the Canals, have resolved to organize an opposition to all railways whatever in Parliament. The canal proprietors are thus openly setting themselves in opposition to one of the greatest improvements of the age.—*Manchester Advertiser*, 30th Jan.

[This reminds us of a flock of geese, whose domains being encroached on

by a herd of elephants, the cackling tribe summoned a grand council, in which after much hissing and quacking debate, it was unanimously resolved to oppose, *vi et armis*, the progress of the elephants. Accordingly they marched forward with extended wings and out-stretched necks, hissing, screaming, and making all the noise of incensed geese. Unhappily, however, the noble animals took no notice of them, but proceeded irresistibly forward; and after some dozen or two had been trampled under foot, an unsaged old gander called off the rest, with this sapient remark, "It is in vain for us to continue the contest. Our adversaries are elephants unconquerably strong, while we are but geese, having only a hiss for our weapon, and quack for our shield."]

FOREIGN RAILROADS.

FRANCE.

The Council of Commerce in France, has given a decision in favour of rail-roads, which has not yet been made public. The Belgian *Moniteur* contains a royal ordinance respecting railroads, the substance of which is as follows:—"In order to prevent accidents at the places where the iron railroads cross the ordinary roads, canals, or rivers, persons on foot or horseback, and carriages of all kinds, are not to proceed along the roads in sight of the train drawn by steam engines, till the latter have passed. They are to let the train pass, and remain at the distance of ten yards. The masters of ships, vessels, and boats of all kinds, must anchor, or stop at the distance of 100 yards from the bridge which they want to have opened, and cannot proceed till they receive permission from the bridge-keeper, who is to let them pass as soon as the train has gone by."

We hope our British legislators will take a lesson by this, and instead of throwing obstacles in the way, endeavour to remove them from the path of the great improvement of the age.—Editor.

RAILROADS IN HOLLAND.

Amsterdam, January 28th.—We have several times mentioned the probability that the preliminary operations for a railroad between this city and Haarlem, would commence in the spring. We now learn that the greatest difficulty lies in the opposition of the owners of the land, over which the road will pass, who are not inclined to part with it.

BERLIN AND POTSDAM RAILROAD.

Berlin, January 22d.—The royal approbation of the construction of the iron railroad from Berlin to Potsdam is confidently expected, and the work will be commenced in two months. It is expected to be finished in about a

year, and to yield nineteen per cent. profit; a result which is the more surprising, as the directors have engaged to take the mails gratis.

RAILROAD BETWEEN PARIS AND VERSAILLES.

The committee appointed to examine into the various plans which have been submitted in reference to this undertaking, are prosecuting their labours with great activity, and it is supposed that the railway will be commenced very shortly.

RAILROAD IN RUSSIA.

"Russia is determined not to be behind the other continental countries in the establishment of iron railroads; the emperor having already approved of plans for laying such roads from St. Petersburgh to the royal residences of Zarsko, Zelo and Peterhoff; one six, and the other eight leagues from the capital."—*Swabian Mercury.*

Limberg, 27th January.—The laying down of the iron railroal will begin in several places at once, and as 30,000 soldiers are to be employed, the work will proceed rapidly. For the first expense 12,000,000 of florins are wanted, divided into 12,000 shares, of 1,000 florins each, the house of Rothschild takes 4,000 shares. To enable the inhabitants of Gallicia who are less opulent, to take part in this undertaking, there are shares of 500 florins. The distance from Limberg to Vienna, will take only twenty hours to travel in a close carriage. For the conveyance of oxen, the wagons will be so contrived that the animals will be able to lie down, and have their bundle of hay before them.—*Algemeine Zeitung.*

RAILROADS ON THE RHINE.

The Strasbourg journals state, that, notwithstanding the opposition of the army engineers of Mentz, the project of an iron railroad from that town to Wisbaden is going on; and that, on the first day of opening the subscription, 1,100,000 francs were subscribed.

TRADE WITH BENGAL.

We understand that the attention of the Bengal government has been directed to the undertaking now on foot, for forming a harbour at or near Corelier Creek, and from thence constructing a railroad to Calcutta, by which the perils of the navigation of the Hooghly will be avoided. It appears that so early as 1770, a harbour in this contiguity was projected as holding forth great advantages, and that the course of the important political events in succeeding years alone prevented its completion. By the construction of a railroad from or near the above creek, a communication with Calcutta will be opened in two hours. The vast sacrifice of life and property by the present passage to Calcutta, has naturally caused an anxiety in the East India Company to promote the adoption of any safer route, to so important a mart for trade as the Oriental capital.—*Morning Herald, 23d Feb.*

LIVERPOOL AND MANCHESTER RAILWAY.

EIGHTH HALF-YEARLY MEETING.—REPORT.

Liverpool, 27th January, 1836.

The Directors have great satisfaction in being able to report to the Proprietors, that the general business of the Railway in the several Departments of Passengers, Merchandise and Coals, has continued to increase. At the Half-yearly Meeting in July last the Proprietors were informed, "that a general reduction had taken place on the part of the Old Quay Company, in the rates of Freight between Liverpool and Manchester." The Directors declined following the example which had been set by their competitors of the Old Quay; and they are happy to be able to state that they have seen no reason to regret the determination which they came to. The following is an account of the Receipts and Disbursements for the

	HALF-YEAR ENDING DECEMBER 31, 1835.		ENDING JUNE 30, 1835.	
RECEIPTS.				
Coaching Department		£67897 19 2		£52437 3 4
Merchandise Do.		46375 15 8		43631 1 4
Coal Do.		3682 8 8		3406 11 4
		117956 3 6		99474 16 0
EXPENSES.				
Bad Debts	£332 15 10		£246 18 4	
Coach Disbursement	10012 15 5		8372 1 8	
Carrying Disbursement	9490 13 11		9257 10 8	
Coal Do.	223 16 8		188 0 7	
Cartage (Liverpool)	101 6 5		73 15 10	
Do. (Manchester)	4266 18 7		3322 14 6	
Charge for Direction	269 17 0		311 17 0	
Compensation (Coaching)	59 17 4		35 3 4	
Do. (Carrying)	3409 16 0			
Coach Office Establt.	688 18 6		693 9 6	
Engineering Department	352 10 0		352 10 0	
Interest	9056 10 8		6878 1 6	
Locomotive Power	15681 17 9		16462 0 0	
Law Disbursement	200 0 0		250 0 0	
Maintenance of Way	7536 10 4		6116 15 10	
Office Establishment	917 15 1		901 10 6	
Police	1154 8 3		1155 7 11	
Petty Disbursement	39 18 4		55 5 0	
Rent	180 6 7		254 5 3	
Repairs to Walls & Fences	724 4 11		699 8 10	
Stationary Engine Disbsmt.	712 2 7		488 10 10	
Tunnel Disbursement	458 17 5		684 3 2	
Tax and Rate	3356 4 11		2157 9 4	
Wagon Disbursement	2767 10 10		2857 6 7	
		71995 13 4		61814 6 2
Nett Profit for Six Months		45960 10 2		37660 9 10
On the preceding Six Months it was		37660 9 10		
Leaving an increase of		£8300 0 4		

N.B.—6219 single trips of 30 miles each, performed this Half-Year. 186,570 miles.

J. D.

The last Half-Year the single trips were 5313, and miles travelled 159,390.

STATEMENT OF RECEIPTS AND EXPENDITURE ON CAPITAL ACCOUNT,

From the Commencement of the Undertaking to 31st December, 1835.

TREASURER, DR. to—	£	s.	d.	CR.	£	s.	d.
Amount of joint Capital in Shares & Loans	1,202,535	0	0	By Amount of Expenditure on the Construction of the Way and Works, including the new Station in Lime Street, &c. now in progress	1,195,156	13	9
Amount of Dividends not paid	1139	8	9	Amount in the hands of Moss & Co. Bankers	37,811	3	10
Amount of Reserved Fund & Interest	4,081	12	3	Do. do. the Treasurer	176	2	6
Surplus in hand after payment of the Tenth Dividend in August, 1835.	1,452	12	5	Do. Arrears on Calls	11	13	6
Nett Profit for the half-year ending 31st December, 1835.	45,960	10	2	Balance of Book Debts due to the Company	22,013	10	0
	£1,255,169	3	7		£1,255,169	3	7

In the Locomotive Power Department it will be perceived that the Disbursements have again somewhat diminished, as compared with the preceding Half-Year, while the traffic has increased; the Directors at the same time having improved their stock of efficient Locomotive Engines.

Considerable progress has been made in the erection of Offices, Coach Sheds, and other Buildings, at the New Station in Lime-street. In conformity with the terms of the different contracts, the works essential to the opening of the New Tunnel will be completed in May next; and the Directors look forward with satisfaction to the period when they shall be able to afford the Public that ample accommodation, and those facilities for the convenient departure and arrival of the Coach Trains, which the limited area and crowded state of the Coach and Coal Stations in Crown-street, and at the Old Tunnel mouth, very frequently render it impossible to accomplish. The expense to the Company at which this increased accommodation will be obtained, and the permanent annual charge at which it must be kept up, the Proprietors are aware will be heavy: but each day's experience demonstrates that improved and extended arrangements in this Department of the Company's business have almost become matters of necessity, rather than of choice.

The new branch line from the Wapping Station to the Timber Wharf at the Brunswick Dock has been commenced. Every facility has been afforded by the authorities both of Liverpool and Toxteth Park, as well as by Mr. Hartley the Engineer for the Docks; and the line of Way being determined on, the Directors hope to carry forward the work uninterruptedly to its completion.

The Directors have been unable to proceed as expeditiously as they could have wished in the general re-laying of the Way with stronger rails; having been disappointed in obtaining Rails contracted for. The price of Iron, they are sorry to say, has advanced fifty per cent. since Midsummer; still, they have thought it expedient not to let the ensuing summer pass without laying down a further considerable quantity; and they have made their arrangements and contracts accordingly. About five miles of double Way have been relaid with stronger Rails, and they hope to put down at least another five miles in the ensuing summer. The Directors at one time were apprehensive that the great work of re-laying the road could not be accomplished without curtailing the usual amount of the Company's Dividends; a measure which they would have felt great reluctance in recommending; notwithstanding the paramount importance, in their judgment, of the object for which the sacrifice would have been required. They are happy however to state, that the result of the last Half-Year's traffic will not only enable them to proceed with the desired work of laying down heavier Rails, but will warrant the Directors in recommending to the Proprietors an addition of 10*s*. per share to the usual Half-Year's dividend. It may be proper however to observe, that the Half-Year just closed is the most profitable of the two, as it includes the season of the greatest travelling; and consequently, that the ensuing six months cannot be expected to shew so favourable a result.

By the accounts which have now been read, it appears that there is a nett balance of revenue over the expenditure of	£45960	10	2
To which add the surplus, after paying the last dividend	1452	12	5
Making	£47413	2	7
The Directors recommend a dividend of £5 ℔ share, amounting to	£39843	15	0
And an appropriation to the purchase of new rails of	6000	0	0
Leaving a balance, to be carried to the credit of the next half-year's account, of	1569	7	7
	£47413	2	7

CHARLES LAWRENCE, CHAIRMAN.

P.S.—The Dividend, as above recommended, being declared by the Proprietors, the Treasurer will be prepared to pay the same at the Railway Office, John Street, between the hours of Eleven and Three, on and after Tuesday the 9th of February next; or the amount will be made payable at Messrs. Barclay and Co.'s, London, or will be remitted in a Bill at a Month, at the Proprietor's option; and the Dividends of parties who have given their orders, will be paid in conformity with such orders.

The nett Profit on Sunday Travelling for the Six Months, amounts to 5*s*. 2*d*. *per* £100 *Share*. [*On the last Half-Year it was* 4*s*. *per* £100 *Share*.]

*** The matter within the brackets is not in the present Report.

From the above statement it will be seen, that the London and Manchester Railway goes on increasing in prosperity. The former half-year the dividend was at the rate of 9 per cent. per annum, but the last at the rate of 10, after setting apart 6000*l*. for the purchase of new rails, and retaining a balance of 1569*l*. more for the benefit of the current half-year. We have looked over many of the Reports with some attention, and confess we think them particularly clear and satisfactory. We are only sorry to see them —which next to the Railway itself, have been of the utmost value to the country, in promoting the formation of Railways—growing gradually less and less explicit. As to the charge which has been made of increasing the dividends out of the capital for the purpose of making them appear greater, or in other words of committing an impudent fraud on the public, we confess we are at a loss to conceive the grounds of it. Besides the improbability of supposing that men of character and respectability would lend themselves to such an action, which sooner or later must be discovered, and cover them with irreparable disgrace, what earthly purpose could it answer? It appears to us to be one of those monstrous absurdities in which erratic imaginations uncurbed by reason may occasionally indulge.—*Editor*.

PETITIONS, ETC. FOR RAILWAY BILLS.

[THE NAMES, ARE THE PARTIES TO WHICH THEY ARE REFERRED.]

Feb. 8, 1836. Hull and Selby; referred to Mr. Bethell and the York List.

Feb. 9. Birmingham and Gloucester; Lord Granville Somerset and the Gloucestershire List.

Feb. 10. London and Brighton; Lord George Lennox and the Sussex Lists.—Midland Counties; Mr. Gisborne and the Derby List.—London and Blackwall; Mr. Alston and the Middlesex List.—Sheffield and Rotherham; Mr. Parker and the York List.—Cheltenham and Great Western

Railway; Lord Edward Somerset and the Gloucester List.—Arbroath and Forfar; Mr. Chalmers and the East Scotland List.—Birmingham and Derby; Sir Eardley Wilmot and the Warwick List.—Stonebridge Junction; Sir Eardley Wilmot and the Warwick List.—Midland Counties; Mr. Chalmers and Mr. Gisborne.

Feb. 11. Arbroath and Forfar; reported, and ordered to be brought in by Mr. Chalmers and Mr. Hallyburton.—Cheltenham and Great Western; reported, and ordered to be brought in by Lord Granville Somerset and Mr. Cripps.—London and Brighton; reported, and Bill ordered to be brought in by Lord George Lennox and Captain Pechell.—Sheffield and Rotherham; reported, and ordered to be brought in by Sir George Strickland and Lord Viscount Morpeth.—London and Blackwall; reported, and ordered to be brought in by Mr. Alston and Mr. Ward.—Hull and Selby; reported, and ordered to be brought in by Mr. Bethell and Mr. Beilby Thompson.—Ulster Railway; referred to Lord Viscount Castlereagh and the Ulster List. —Birmingham and Gloucester; reported, and ordered to be brought in by Lord Granville Somerset and Mr. Hope.

Feb. 12. Midland Counties, with Branches, near the London and Birmingham, to communicate with the towns of Leicester, Nottingham, and Derby, and with the Mansfield and Brixton Railway: ordered to be read a second time.—London and Blackwall, with a Branch to the West India Docks; to be read a second time.—London and Brighton; to join the London and Southampton, near London, by way of Shoreham; to be read a second time.—Sheffield and Rotherham, with a Branch to the Greasbrough Canal; to be read a second time.—Cheltenham and Great Western, to join the Great Western, near Swindon, with a Branch to Cirencester; to be read a second time.—Birmingham and Gloucester; to be read a second time.—Ulster; ordered to be brought in by Lord Viscount Castlereagh and Lord Viscount Achison.—Hull and Selby; to be read a second time.

Rail-road Bills; Motion made and Question Proposed, That a Committee be appointed, to which shall be referred any application for a Bill for any Rail-road having a termination within seven miles of the Royal Exchange; and that before any such Bill be allowed to be read a second time, the committee do report upon the desirableness of the proposed rail-road; and whether the best line has been selected, having regard to the directness of the communication, the probable expenditure, the comfort and safety of the public, and the effect upon private property, and particular interests; (Mr. Harvey); motion by leave withdrawn.

Feb. 15. Leeds and Derby; referred to Sir John Beckett and the York List.—Gateshead and Durham; Mr. Pease and the Durham List.—London and Gravesend; Sir William Geary and the Kent List.—Birmingham

and Derby; reported, and ordered to be brought in by Sir Eardley Wilmot and Mr. Dugdale.—Stonebridge Junction; reported, and ordered to be brought in by Sir Eardley Wilmot and Mr. Dugdale.—Hayle Railway; Mr. Pendarves and the Cornwall List.—Manchester and Cheshire; Mr. Wilbraham and the Lancaster List.—Ulster; from Belfast to Armagh; to be read a second time.—Bristol and Exeter; Mr. Miles and the Somerset List.—Arbroath and Forfar; to be read a second time.

Feb. 16. Leeds and Derby; reported, and ordered to be brought in by Sir John Beckett and Mr. Baines.—Birmingham and Derby Junction; to be read a second time.—Stonebridge Junction; to be read a second time.—Great Western; Mr. Charles Russell and the Berks List.—Manchester and Cheshire; reported, and ordered to be brought in by Mr. Wilbraham and Mr. Wilson Patten.—London and Blackwall Commercial; Mr. Patrick Stewart and the Middlesex List.—Holbeach and Gedney; Mr. Tooke and the Lincoln List.—Dundee and Arbroath; Mr. Chalmers and the East Scotland List.—Bristol and Exeter; reported, and ordered to be brought in by Mr. William Miles and Mr. Ashford Sanford.

Feb. 17th. North of England; reported, and ordered to be brought in by Mr. Pease and Sir Hedworth Williamson.—London Grand Junction; Mr. Ormsby Gore and the Middlesex List.—Manchester and Cheshire Junction; from Manchester to join the Grand Junction, near Crewe Hall, Chester, to be read second time.—Stockport and Manchester; referred to Mr. Bootle Wilbraham and the Lancaster List.—Merthyr Tydfil, and Cardiff; Mr. Guest and the Wales List—London and Croydon; Captain Alsager and the Surry List.—London and Gravesend; reported, and ordered to be brought in by Sir William Geary and Mr. Law Hodges.—Great Western; reported, and ordered to be brought in by Mr. Charles Russell and Mr. Serjeant Talford.—York and North Midland; Mr. Lowther and the York List.—Hayle; reported, and ordered to be brought in by Mr. Pendarves and Sir Charles Lemon.

Feb. 18th. London and Gravesend; from Greenwich to Gravesend, with a Station for the use of the same in the Borough of Southwark; to be read second time.—Birmingham and Gloucester; Petition of inhabitants of Tewkesbury against; to lie on the table.—Stockport and Manchester; reported, and ordered to be brought in by Mr. Bootle Wilbraham and Mr. Thomas Marsland.—Gartshevrie and Cootbridge; Mr. John Maxwell and the West Scotland List.—Newcastle and North Shields; Mr. Bell and the Northumberland List.—Brandling; Sir Matthew Ridley and the Durham List.—Dundee and Arbroath; reported, and ordered to be brought in by Mr. Chalmers and Mr. Hallyburton.—Merthyr Tidfil, and Cardiff; reported, and ordered to be brought in by Mr. Guest and Mr. Dillwyn.—Deptford,

Mr. Barnard and the Kent List.—Preston and Longridge; Lord Stanley and the Lancaster List.—Manchester and Leeds; Lord Stanley and the Lancaster List.—Hayle; to enable the Hayle Railway Company to make certain alterations in the lines of such railway, and for other purposes relating thereto; to be read second time.—London and Dover; Mr. Fector and the Kent List.—Gateshead and Monkwearmouth; Sir Edward Williamson and the Durham List.

Feb. 19th. London and Brighton, No. 2; Captain Alsager and the Surry List.—Manchester and Leeds; reported, and ordered to be brought in by Lord Stanley and Sir George Strickland.—London Grand Junction; reported, and ordered to be brought in by Mr. Ormsby Gore and Sir Samuel Whalley.—Stockport and Manchester, from Heaton Norris to Manchester; to be read second time.—Thames Haven, Tide Dock; Mr. Branston and the Essex List.—Glasgow and Airdrie; Mr. Gillon and the West Scotland List.—Polloc and Gavan; Mr. Gillon and the West Scotland List.—Dublin and Kilkenny; Mr. Ruthven and the Leinster List.—London and Blackwall Commercial; reported, and ordered to be brought in by Mr. Patrick Stewart and Mr. Humphrey.—York and North Midland; Mr. George Cavendish and the Derby List.—South Durham; Mr. Bowes and the Durham List.—Durham Junction; motion made and question proposed, that the said Petition be referred to a Committee; debate thereupon adjourned till Monday next.—Aylesbury; Colonel Hanmer and the Buckingham List.—Bolton and Leigh; Mr. Wilson Patten and the Lancaster List.—Dundee and Newtyle; Mr. Hallyburton and the East Scotland List.—Northfleet and Dover; Mr. Plumtre and the Kent List.—Merthyr Tydfil and Cardiff; to be read second time.—Birmingham, Bristol and Thames Junction; Mr. Clay and the Middlesex List.—Great Western Railway, (No. 1); to alter the line of the Great Western Railway, and to amend the act relating thereto; to be read second time.—Great Western (No. 2); Mr. Charles Russell and the Gloucester List.—York and North Midland; reported, and ordered to be brought in by Mr. John Lowther and Mr. John Dundas.—London and Cambridge; Mr. Bagshaw and the Cambridge List.—Monkland and Falkirk; Mr. Oswald and the West Scotland List.—Edinburgh, Leith, and Newhaven; the Attorney General and the East Scotland List.—London and Norwich; Sir Charles Brooke Vere and the Essex List.—Festiniog; Colonel Parry and the Wales List.—London, Shoreham, and Brighton; Mr. Hawes and the Surry List.—Great Northern; Mr. Scarlett and the Norfolk List.—Chelmsford Railway; Mr. Scarlett and the Essex List.

No. of Shares.	RAILWAYS.	Dividend per Annum.	Dividend when payable.	Amount of Shares.	Sums paid.	Highest and Lowest Price.
—	Birmingham and Derby . .	—	—	—	5*l.*	13½a12½
—	Birmingham and Gloucester .	—	—	—	—	9a½
—	Bristol and Exeter . . .	—	—	—	2 10	4¼a½
660	Bolton and Leigh . . .	—	—	100	—	100
350	Cheltenham . . .	—	—	100	—	78
2,000	Clarence	—	—	100	100	40
12,000	Commercial Blackwall .	—	—	50	2	3½a2⅞
1600	Cromford and Peak Forest .	—	Mar. & S.	100	—	
60,000	Eastern Counties . . .	—	—	25	1	1¼
2,500	Forest of Dean . . .	19*s.*	—	50	—	28
800	Durham Junction . .	—	—	100	10	
—	Grand Junction . . .	—	—	100	40	
—	Great North of England . .	—	—	—	2	3¾
25,000	Great Western . . .	—	—	100	10	35a32
2,000	Hartlepool	—	—	100	100	80
2,100	Hull and Selby . . .	—	—	50	5	10a9½
—	Leeds and Manchester . .	—	—	—	5	11⅞a13
7,000	Leeds and Selby . . .	—	—	100	—	120
1,500	Leicester and Swannington .	—	—	100	100	48
5,100	Liverpool and Manchester .	9*l.*	—	100	100	240
10,000	London and Brighton (Stevens)	—	—	100	5	21a15
45,000	———— (Gibbs)	—	—	20	1	
16,000	———— (Rennie)	—	—	50	2	5a2⅞
12,000	London and Blackwall . .	—	—	50	3	4¼
—	London and Dover . . .	—	—	50	1	1⅝
30,000	London and Gravesend . .	—	—	20	1	2⅝a2⅛
20,000	London and Greenwich . .	3*l.*	Ap. & Oc.	20	20	30a29½
25,000	London and Birmingham .	—	—	100	50	124a3
20,000	London and Southampton .	—	—	50	15	23¼a22½
7,000	London and Croydon . .	—	—	20	2	3⅜a3
12,000	London Grand Junction .	—	—	50	2	2½a2
14,000	Manchester and Chester . .	—	—	50	2 : 10	
1,000	Manchester and Oldham .	—	—	100	3	
—	Midland Counties . . .	—	—	—	5	10
553	Monmouth	—	—	50	—	
—	North Midland . . .	—	—	—	5	10½a10
—	Northern and Eastern . .	—	—	100	3	4⅝a4
2,500	Preston and Wigan . .	—	—	—	20	
2,600	Preston and Wyre . . .	—	—	50	3	13a12
1,000	Stockton and Darlington .	6*l.*	Ap. & Oc.	100	—	
1,500	Stanhope and Tyne . .	—	—	100	100	
—	South Durham . . .	—	—	—	2 : 10	3a2⅝
—	South Eastern . . .	—	—	—	2	2⅞a2½
—	Warrington and Newington .	—	—	100	—	
6,000	York and North Midland .	—	—	50	1	5a4½

THE RAILWAY MAGAZINE;

AND

Annals of Science.

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ON THE LAYING OUT OF A RAILWAY.

By the Editor.

It is a fact no less true than surprising, that notwithstanding the experience we have had for some years of the utility of rail-roads, there appears to be no fixed principle on which they are planned. Our engineers seem like men working in a fog; all is confusion and uncertainty. One follows the course of the rivers: a second skips like a goat at once to the tops of the hills, on what is called the principle of concentrating the inclinations: a third, as if he delights in filth and darkness, or is ashamed to be looked at in the light, burrows for a considerable portion of his way under ground; a fourth, in the true spirit of the man and his ass, lays out his line, twisting about like an eel to suit every little hamlet in the way, scarcely heeding difficulties, or whether his line will be a workable one or not; while a fifth runs into the very opposite extreme. This one shuns the towns, and wanders through wild, unfrequented places, and then boasts of the little expense of his line, forgetting that it is the returns derivable chiefly from the very towns he avoids, which are to repay the shareholders for their outlay.

What does all this prove but that *system* is utterly wanting, and that our civil engineers have neither line nor rule to work by? This appears the more remarkable, as a little thought would at once have suggested the chief principle on which every rail-road ought to be constructed, and without conforming to which, no one ought to be permitted. Without pretending to do the subject full justice, I shall here sketch a few plain rules, which, from their simplicity, deserve rather to be called

RAIL-ROAD AXIOMS.

ON THE PRESERVATION OF EXISTING INTERESTS, DOMESTIC PRIVACY, AND INTERMEDIATE TRAFFIC.

1. *The first great principle is, that every line should be so laid out that it may diffuse the greatest quantity of benefit to the country lying between the place from which it starts and that to which it is intended to be carried.*

For it is beneficial to the shareholders in the direct ratio of the general benefit it confers on others. Now this maximum benefit

never can be attained but by approaching within the minimum distance of the seats of trade and commerce—that is, of great commercial towns. It is in vain to carry a line through wild and unfrequented parts, or near paltry, inconsiderable places. It would in fact be worse than vain: it would be useless to those insignificant places, and a direct positive injury to the large towns it avoided. For it would be like taking seed from a rich and luxuriant soil, to sow it where there is none to receive it.

I could point out several lines which have made this unfortunate mistake; but not one in a more eminent degree than the South Eastern—a line proposed to go from London, and after making a fine flourish, for no earthly purpose that I can perceive, out of Surrey into Kent, proceeds by the unimportant place of Tonbridge, through the Weald of Kent to Dovor. The whole population of the chief towns through which it passes, exclusive of Dovor, is only about 28,580; that is, less than that of the united villages of Dartford and Greenwich, and upwards of 30 per cent. less than that of the villages of Deptford and Greenwich, and only 4000 above the population of the single village of Greenwich; while the population it actually leaves unprotected, amounts to near 128,000.

2. *All existing interests, except those directly affected by the new mode of transit, should be interfered with as little as possible, unless beneficially.*

The interests directly interfered with are obviously the carrying, whether by long stages, wagons, vans, &c. To talk of protecting these interests, therefore, from the interference of rail-roads, is absurd; the very object of the latter, being an improvement which amounts to a superseding of the former. But if a rail-road be so projected as to make communication with it inconvenient to the largest places now existing, or to transfer the trade, or deteriorate the property, by raising up other places to their disadvantage, such a rail-road would be highly injudicious; a curse, not a blessing; and ought to be rejected at once by the legislature, whose duty it is to watch over and protect the property and interests of the public.

3. *The new line of traffic ought to deviate from the old, wherever towns are concerned, the least that the ground will permit.*

This is so obvious a consequence of the preceding principles, as to need no comment.

4. *Domestic comforts or privacy should not be invaded, if it be possible to avoid it.*

Though no one can dispute the wisdom of the maxim "that private interests should yield to public," yet every man's own bosom will tell him that his, and consequently any other person's private comforts, ought not to be wantonly invaded, nor old attachments

violently severed, until every other means of rendering to the public the service it needs had been tried and found to be impracticable, or unequal to the object.

5. *In laying down a line of railway between two distant towns, an especial regard should be had to intermediate traffic and population; and every town, other things being alike, should approximate to the line of railway in the direct ratio of its public importance.*

This is a principle which seems to be the least of all understood by engineers. I think I may venture to say, that if our engineers were examined, there are but few of them who could shew that they have at all attended to this principle, though it is the most important and comprehensive of all. I shall therefore make no apology for going into its detail a little farther than I have into that of the others.

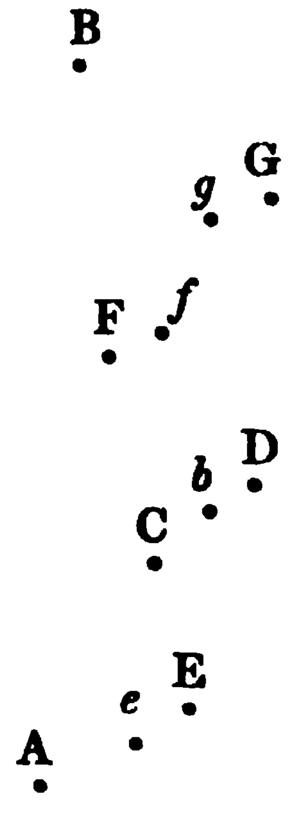
One may here very properly inquire, What is public importance? It is summed up, it appears to me, in two words—trade and commerce, estimated by the annual amount of returns. There is no trade nor any species of commerce, as far as I am acquainted, but what is publicly advantageous. To lay any unnecessary impost on it, therefore, whether it be in the shape of tax, expense of transit, &c., is a clog on the trade, and an injury to the public. Far better is it that individuals be taxed, even if it be the tradesmen themselves, than that the commodity should; for, in the one case, it is an impost on an individual, in the other, on the community.

Hence a very delicate point arises between the public and the projectors of rail-roads, in which the interests of both are not always blended, and may be at variance. For example, suppose nearly in the route in which a line of rail-road is projected two towns lie, one of which may have a considerable travelling population, and little or no trade, while the other has little travelling population and considerable trade; what would be the consequence? Why the projectors would evidently lay their line as nearly as possible to the former, because of the immensely greater profit that they get on the carriage of persons, and relatively neglect the latter, especially if the trade consisted in the manufacture of heavy goods. Here then, would be private interest in opposition to public, imposing a somewhat difficult task on the legislature, to decide between them. The directors would very naturally urge the necessity of laying out their railway where it is likely to be most profitable to the shareholders. They would very plausibly argue that it is at their own risk they have undertaken it, and their own money is to pay for it; that it is their duty, and no less so that of parliament, to see that the shareholders have the best possible return for their risk and capital expended. On the contrary, the legislature might fairly observe, "you come to us to grant you our authority to pull down the house of one, to cut through the lands of another, to take from him those of a third, to invade the privacy of a fourth, to drive from his house and rend asunder the old attachments of a fifth, and to destroy perhaps the business and means of subsistence of a sixth. All this

you ask us to authorize you to do for your own private gain; for after all, this is your object. But we must not forget that it is our duty to protect all parties, especially the general body of the community. While we keep one eye on the interests of your shareholders, we will watch with the other, and defend with both hands the interests of the public. We will see that you furnish a *quid pro quo*. For the depredations you contemplate on private property and comforts, we will insist that you shall render a full equivalent to the public, by strengthening, to the utmost your scheme will admit of, one of the links of that chain which holds together the common interests of all. This you can accomplish in no other way than by leaving the town of idlers, and going the nearest possible to the seat of trade, and that therefore we shall insist on."

Who would not say that such would be the fair reply, and proper line of duty for the legislature to pursue? A question then arises how the line is to be laid out, so as to give to each town its due share of the benefit of the railway where several towns lie scattered between the two termini. I will endeavour to see if I can answer this. If I should not be successful, it may at least lead others to think on a subject which as yet appears to have arrested but little of attention, although the most important object of any in the laying out of a line of railway.

Let us suppose that A and B are two towns, between which it is intended to construct a railway, and C, D, any other two towns lying obliquely to the line, whose traffic it is intended to embrace; and let us in the first instance, for simplicity sake, suppose the ground every where equally favourable. Now if the two towns A and B alone were to be considered, a direct line would evidently be the natural one to be constructed, leaving C and D to the right; but D much more than C. This, however, would be very unfair towards D, inasmuch as it may happen that the town D is a place of quite as much public importance as C, and perhaps more. For what would be the effect, but to raise up the nearer place C, at the expense of D, and consequently to injure the existing interests of D, by giving the former greater facilities of communication with the chief marts A and B than it is entitled to?



To obviate this, let the distance between C and D be divided in *b*, so that C *b* is to D *b* as the trading or commercial returns of D, (for these I apprehend are the true measure of public importance) are to the like returns of C. Carrying the line of railway through this point will be, as nearly as possible, giving to each its due weight in the balance of benefit. Following the example of mathematicians in a similar case, we may call this point *b*, the centre of commerce of the two towns C and D.

The above method supposes that it is a matter of importance to the two termini towns to take in the traffic of the two intermediate towns, and of indifference to turn the line of railway to the extent needed, out of its direct course. Such in practice is actually the case, when the termini are far apart, or the centre of commerce of the intermediate towns not far out of the direct line; for to turn a little to the right or left, increases the distance so triflingly as to render it immaterial.

If there is a third town E, whose traffic it is needful to include, a point *e* should be found distant from E, in proportion to one of the previous distances D *b*, as the commercial importance of the denominating town D is to that of E; which, on the same principle, will be another point through which the line ought to pass, giving to E its due participation in the railway. In the same way, may a point *f* be found, for a fourth town F, and so on for others to any number.

Were it to happen, that one or more of the points *e*, for instance, so computed, would bend the direct line from *b* to B, out of its course concave to F, it is obvious the method ought to be abandoned. The line under such circumstances should be permitted to follow the straight course, and F left to enjoy the advantages nature has given it of having the railway a little nearer to it than its relative importance has a right to claim.

If instead of single towns E or F, there should happen to be a pair of them F, G, whose line of communication is transverse to the grand line of railway, then it will be advisable to proceed with finding the centre of commerce *g* of them, independently of the others, in the same manner as we did with *b*, that of the towns C, D. This new point will be that instead of *f*, through which the railway should pass.

Presuming the ground to be everywhere equally favourable, this I apprehend, would be the way to lay out a line of railway, so as to give to each town its due and proportional share in the benefits of the railway; and preserving to commerce and the public, the maximum advantage to which they are entitled. If the ground is not equally favourable, then it is manifest that these points should be determined first, and the line kept as near to the direction they would have given, as the ground will permit.

In a similar way should we deal with towns of mere population. They might very fairly be compared with one another, though we would not admit of a comparison between them and the strong holds of trade. In these cases the importance of the towns must be measured by their population.

ON CROSSING ROADS, LONG TRACTS OF LOW COUNTRY, AND NAVIGABLE RIVERS.

6. *A turnpike road should on no account whatever, be permitted to be crossed with a rail-road on a level.*

The same will hold good, but less forcibly with any public path or highway. To this we may add that it would be preferable for the

railway to be as free as possible from inclines, at about the crossings. If it could, it would likewise be better for the rail-road to pass over rather than under any public road; for it would then be more out of the reach of passengers, and therefore be safer for the trains. But there are places in which this would be unadvisable, or perhaps impracticable.

7. *Long tracts of low flat country should be avoided as unfavourable to railways, not only on account of their dampness and interruptions to the good working of the trains, but more particularly if crossed by navigable rivers or canals, as generally more expensive, less convenient, and less safe for a rail-road than a country gently undulating.*

8. *Whenever a rail-road has to cross a navigable river, it is always advisable to do it at such an elevation as to avoid a swivel bridge.*

If it be considered that a train going at a great velocity cannot be pulled up at once like a stage coach, and that it frequently takes near half a mile to arrest it, we shall immediately see the danger and impropriety of admitting these bridges. It would in all cases be much better if the legislature would compel the vessels passing to strike their top masts, and let the company allow some trifle for it, rather than to run the risk, particularly in foggy weather, of having the whole train hurled into the water. Who would think of intersecting any public highway with a dangerous chasm or ditch? And what are rail roads but a new kind of turnpike road, the child indeed of necessity?

But probably there may be no actual need for a swivel bridge, or to make the vessels strike their mast. According to the velocity which the engineer can command on either side of the river, he may elevate his rail road over it, by reasonably abrupt ascents of from 10 to 30 feet above the general level of his line on each side, and ascend by the force of impetus, the engine merely doing the work on a level. This subject will be more largely handled when I come to treat of railway gradients.

TUNNELLING.

9. *Tunnels ought to be especially avoided.*

It is not merely on account of the great cost of their construction, the expense of gas and other establishments, afterwards entailed on them, but the excessive nuisances which it is morally impossible to prevent, and the danger to delicate constitutions of travelling through such holes of impurity. Let any one of a tender habit—and thousands of such must and do travel daily—who doubts this, go through the Thames and Medway tunnel, or the Canterbury and Whitstable, and he will at once be convinced not only of the nuisance but of the danger of them. The latter is so proverbially in the neighbourhood the sink of colds, &c., that I have been informed very few will venture into it at all, and the railway consequently carries scarcely any passengers. As to the former, a gentleman and myself went down last August the 3d, a light fine day, on purpose

to see it. We commenced at the Medway end, with a determination to walk through it. The tunnel being large and cut in chalk, we at first found it light and not uncomfortable, but when we had reached about 500 yards, the darkness became so intense, that we could neither see the path we trod, nor distinguish it from the water beside us. At the same time the atmosphere grew so oppressive, that it was with difficulty the gentleman with me could walk from a giddiness in the head, while I felt full, hard pains in my chest. We were therefore both obliged to abandon our intention, and return. A similar account was given to me of another party of several who went on a like excursion. If such then be the effect on persons not naturally very delicate, and when no locomotive engine is travelling, what would be the consequence on tender constitutions, and when the nuisance is accumulated by locomotive, after locomotive?

But it may be asked, "Suppose there are two towns of great traffic which cannot have a railroad communication without a tunnel, what would you do, not make a railroad, while all the rest of the country is enjoying them?" The answer is obvious, "Our rule is general not universal;" try every means first—try an inclined plane with a fixed or assistant engine, and when every thing else has failed, but not one moment before, have recourse to your tunnel, not as desirable, nor a matter of choice, but of stern necessity.

I should indeed prefer an inclined plane, even if the initial and annual expense were much greater than with a tunnel; for I am in great hopes that a few years will shew us locomotives working up those inclinations with their loads, which now they dare not attempt. Besides, the passenger trade may so increase, as to reduce year after year the relative expense of the fixed or assistant engines; while I fear, through a tunnel, this trade, which is the most profitable of all, would rather decrease, the more the nuisance becomes known.

While I am on this subject, I do not know that I can do better than reprint the observations, with some additions, which I published some time ago on tunnels, in a work not likely to come under the notice of the respectable readers of the RAILWAY MAGAZINE.

OF THE LIGHTING OF TUNNELS.

IT has been gravely talked of lighting tunnels artificially, so as to supersede the necessity of day-light. How or by what means this is to be done, remains a secret. To philosophers and practical men, the hopelessness of approaching the solar by any artificial light is well known. Sir John Leslie computes, from experiments, that a piece of the sun's matter less than half an inch diameter would give more light than 12,000 wax candles; and every light we know of, even the hydro-oxygen light, I am informed, the most intense by far yet discovered, sinks into a dark spot when held up before the sun's disk. It has been computed by Bouguer, that the light sent us by the sun exceeds that by the full moon 300,000 times. Coarse as our optical nerves are in judging of degrees of light, it would, therefore, be impossible to have a sudden transition from solar to lunar light without producing the sensation of great darkness; and it is only to the slow and insensible gradations, first of the descending sun, and then of twilight, occupying at least an hour, that we are enabled to bear so great a difference.

But what would be the time of passing from broad daylight, with a train in full speed, to the intense darkness of a tunnel—a single second! Not more if the velocity was thirty miles an hour; for in that space the train would go forty-four feet. Any one, therefore, may judge for himself of the effects of so instantaneous a transition from the full light of day to that of the full moon, could such a light, and so diffused, be introduced into a tunnel, which I apprehend to be impossible.

But it is not the transition from light to darkness which is anything so bad as the contrary—from the intense tenebrosity of a tunnel to the full broad glare of day-light. Let any one, with his face towards a strong light, as a window in a room, look at his eyes reflected from a mirror, and he will perceive the pupils of them contract to very small dimensions. Let him now turn to the darker parts, and the pupils will in a little time expand to four, six, or perhaps ten times their previous area. If he once more turn sharply to the stronger light, he will observe his pupils contract to their former dimensions pretty rapidly, but by no means instantaneously. This contraction will be for the purpose of excluding so much of the strong light as is unnecessary for the distinct visibility of objects, and which would distress and injure the optic nerves. In young and healthy persons the contraction and expansion will be much more marked than in old, debilitated. Now let us suppose, from having been shut up within a coach in a tunnel for a few seconds, the pupils of the eyes had attained their utmost distension; and let us for one moment consider, in the state of this unusual distension to nine or ten times their natural size, that a light from 500,000 to probably 1,000,000 times greater than that of a mould candle, was all at once to burst upon so delicate an organ! I appeal with confidence to any medical man to answer the question of the effect—particularly if often repeated—on a tender constitution and sight.

It is well known that any object, not illumined directly by the sun, depends for its visibility on the indirect light falling on it from all visible points, especially from that portion of the sun's rays intercepted and diffused in every direction by the particles of the atmosphere; and that the more this indirect light is diminished, the darker the object grows. Hence it is, that in descending an uncovered well or pit, the indirect light is gradually curtailed until it is too weak on the eye to resist the feeble light of the stars, which become visible, though that indirect light comes from a column of atmosphere thirty miles high illumined by the sun. On the same principle, too, it is, that when the eye is protected from the indirect light by a long tube, darkness so increases on it that the stars may be seen as well as in a pit. So also on the Andes, the brighter planets and stars may be detected in the day, which happens on account of almost half the indirect light being there lost by these lofty mountains rising above nearly half the actual substance of the atmosphere, though to scarcely a tenth of its altitude.

If, therefore, the visibility of bodies depending on Nature's most powerful light, diffused by the whole extent of the atmosphere, is so very easily destroyed, how is it possible in the contracted limits of a tunnel, boxed up besides in a coach, any artificial light, far inferior to the sun's, can cause that luminous diffusion needful to produce general visibility of objects? The idea is too absurd to be entertained by any one not interested in propagating it. That a tunnel can be so lighted that a person may walk in it, is obvious; but in carriages it would be light where the lights fell, and intense shade where they did not. I have myself walked up and down the Liverpool short tunnel, about 300 yards, without much inconvenience; but when I entered it in a train, impenetrable darkness ensued, disturbed now and then by the gas, whose sickly and jaundiced hue seemed calculated only to render the horrors of the place more apparent.

It has been hinted to me that Mr. Stephenson, the engineer, intends to light his tunnels so as to do away with the objections to the want of daylight.* I should rejoice to see it; but I cannot believe that Mr. Stephenson, who is often styled "the Pope of Engineers," could give rise to so silly a report. That Mr. S. is an industrious, ingenious man, no one can doubt; but to say that he claims to be able to do that which men much more conversant with the subject judge to be impossible, is to throw an odium on him for arrogance and presumption, which I cannot imagine he merits. I would as soon believe Mr. Stephenson had declared his possession of the Laputan philosopher's desideratum, namely, a method of bottling up the summer sun's rays to grow cucumbers with in winter.

What has been said, presupposes the atmosphere of the tunnels perfectly clear and transparent; but the moment an engine enters, the confined air will be intermingled with a vast volume of dense steam and smoke. And since each succeeding engine will add to the nuisance of its predecessor, I should be glad to learn how a tunnel of any length is to be cleared, if there be much traffic on the line, and by what legerdemain any one will undertake to send a light through such an atmosphere. Would it not savour more of sober reason, at the end of each tunnel to provide the means of ablution from the filth the poor passengers had contracted, with an antidote of some kind to neutralize the smoke and steam they had swallowed, and a cordial to revive their exhausted spirits?

OF THE PERMANENCE OF TEMPERATURE IN TUNNELS.

About eighty feet under the surface experiments have shewn that the temperature varies seldom more than a degree all the year round. This, therefore, presents another serious objection to tunnels. For as tunnels are seldom made unless the superposed ground exceeds eighty feet, it follows that the temperature of them cannot differ much from the mean temperature of the soil, or 51°, at any season of the year. A person, therefore, leaving the external air of a hot summer's day, may change an open dry air for a damp cold one, perhaps 30°, 40°, or 50° lower. Now, if any time was spent in the tunnel, or if accident should detain the train, this would be no trifling change so suddenly made to any constitution. A miniature effect of it may be felt in St. Paul's in a hot day, by a cold current of air about the ankles. But I have heard that in the Thames tunnel, which Mr. Canning very significantly denominated "a great bore," the sensation is very chilly and unpleasant. However, as the air is a weak conductor of heat in respect of quantity, though it transmits it rapidly, that is, at the rate of 1100 feet per second, it is possible in the passage of quick trains the change within the carriages would not be so much felt. But there is another point in which the constancy of temperature in tunnels would have a very powerful, and, I fear a very pernicious effect. I allude to the

VENTILATING OF TUNNELS.

Tunnels for locomotive engines must evidently be horizontal, or so nearly so that they could never ventilate themselves. Omitting the perpetual liberation of vapour from the sides and ground of the tunnel, which, if it was only to render the confined air thoroughly damp, is bad enough; the

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* One of the methods I have heard, is to make the carriages carry lights. Success would be more certain, to carry off all the earth above, and on the sides, and make a glass tunnel, and do away with the locomotive engine too. If a diffused light can be thrown into a tunnel, Mr. S. may take a hint from this, and have glass panels, &c. to the carriages.

incessant escape of gas, and, much more, the decomposition of the atmosphere and destruction of the vital part of it by the lights, would soon render the air totally unfit for human respiration. These effects would be more marked and serious as the tunnel is longer. Various methods, therefore, have been proposed to insure that constant supply of pure air indispensable for comfort and safety. The most approved, I believe, is that by vertical shafts from the tunnel to the top of the ground. Some have suggested the creation of artificial currents up these shafts. To me the success of the notion appears about as probable as that of men flying. It would be far more profitable to turn their attention to improve the power of the engines in climbing ascending planes. In winter these may answer, so as to cause a circulation. The external air being then much colder, and consequently, heavier than the internal, would force its way in at both extremities, driving the impure lighter air up the shafts. Or the external air may descend in the middle of a shaft, round the sides of which the internal air is ascending, and by that means keep up a steady circulation, though not a pure air. But how would it be in the height of summer, when the temperature of the internal air falls considerably under that without and above? Before any disposition to change can arise, the internal air must become specifically lighter than the external, which can happen only by admixture with a sufficient quantity of the noxious vapour of the tunnel, or of the gas which lights it. That is, before any tendency to circulation can occur, the air must be surcharged with pestilent vapour and deadly gas; and this at a season of the year, too, when pure air is most needed, and our bodies are most obnoxious to disease. Let the medical man, who knows that an inspiration or two is often sufficient to implant the germ of incurable disease, say whether such a state of things should be allowed.

Mr. Stephenson, in his evidence in the House of Lords last year, I am informed, stated, " he could see no objection to a tunnel twenty miles long." Having given his opinion on oath, we are bound to admit he believes it. But is Mr. Stephenson philosopher enough to know the *modus operandi* of matter?—has he medical skill to determine the precise limits to which we may go, without deranging that most delicate of all balances, the balance of health?—or does he think his notions of what is, or is not, objectionable, are to be the standard and law of the world? If not, on what grounds does he presume to give such an opinion? Mr. S. will pardon my telling him so, but such imprudent assertions will presently lead Englishmen to believe, that his knowledge of nature is about equal to that of his brother in title, Pope Callixtus, who solemnly excommunicated, with his enemies the Turks, the comet of Halley, because, from its tail resembling their scymitar, his holiness thought the poor star had come to aid and partake of their devastations.

OF THE SMOKE, NOISE, &C. IN TUNNELS.

Until very lately I was not aware there was any tunnel in which a locomotive engine dragged a train with passengers. I hear there is one of about 800 yards between Leeds and Selby. A gentleman who had been through it thus described it to me. " We were immediately enveloped in total darkness, and every one of the carriages filled with smoke and steam to a most annoying degree. Though we were but a few minutes going through, such was the nuisance, we thought it an hour." He was there once, too, when the train struck against some scaffolding, which had been used to whitewash the tunnel. "The crash," he said, " sounded terrible; and the turning off of the steam," which I think, in the open air, would barely have been heard inside of a carriage, " resounded like the report of artillery; and both men and women were so alarmed and frightened, that they declared their apprehensions of immediate death."

This is a specimen of tunnel-travelling with locomotive engines. Let every one decide for himself whether they are nuisances or not, and whether from this one sample of one of half a mile, he can agree with Mr. Stephenson in seeing no objection to tunnels twenty miles long. Surely, some men see their reasons through golden per centages, and draw their arguments from profits. It is to be hoped, however, that the legislature will see this matter in a true and just light; that they will consider the objections there ever must be to tunnels, the nuisances they will be to the public, the extravagant expense of their construction, the certainty of such lines being ultimately superseded by other lines without tunnels; and that they will really prove themselves the guardians of the subscribers and friends to the public, by setting their faces against any bill in which tunnels are proposed.

By this means they will confer a real benefit on the present and future generations, while the only injury they can do, will be to prevent a few engineers from amassing large fortunes by their per centages on sums needlessly drawn from the public, and uselessly and ruinously wasted. That good working lines for railways, to most of our great towns, can be found free from tunnels, I have been informed, and have no doubt of it; why then should they not? Colonel Landmann has set engineers an example, which it would be well for the public if others were compelled to follow, and would save the waste of millions of money.

I have said nothing of the consequences of tapping springs in tunnelling, simply, because I did not wish to swell the catalogue of objections and dangers. But men of discernment will soon see, that a pressure, which amounts to half a pound for every foot of perpendicular altitude of the origin of the spring, that is, if it be 480 feet high, of one cwt. per square inch, one ton, two and a half cwt. on the edge of every brick, or seven tons four cwt. on every square foot, is not to be lightly passed. Neither is this destruction of springs to be disregarded, which may cause irreparable mischief many miles off.

(To be continued).

ON THE LIMITS TO THE MANUFACTURE OF IRON, AND THE QUALITY BEST SUITED FOR RAILWAYS.

To the Editor of the Railway Magazine, &c.

SIR,—So important a subject have rail-roads now become, that any thing relating to them is looked upon as a matter of some consequence: it cannot, therefore, be expected that what relates to the iron trade should form an exception, iron being an article of the first importance for the completion of these undertakings.

Some persons appear to think that the great demand which now exists for this article, will cause iron works to spring up in all directions, something, I suppose, after the manner of mushrooms, gold being the spawn from which they are to be raised. But although the present high price and great demand will undoubtedly cause the production of iron to be stretched to the utmost, still the amount of that production is not without its limits, and is, perhaps, more difficult to extend than is usually supposed. I do not doubt that if speculation should chance to turn upon the subject of iron works in the way it

now does on rail-roads, that we should presently have many projects of this kind; but whether they would afford a return for the capital invested, is quite another thing.

There is, perhaps, no speculation worse suited for a public company than iron works and mines. The expensive and cumbrous machinery for the management of public bodies, is but ill suited to the iron trade, where the very essence and soul of prosperity, are economy and enterprise. However useful public companies may be for those undertakings unattainable by individual wealth and energy, they cannot cope with individual competitors in a business where promptitude and foresight constitute the main qualifications, and economy the chief gain. The opposing interests, the sluggish routine formalities, and the want of an energetic concentration of mind, which are inherent in all public bodies, give to individual speculators an advantage which is still further increased by the greater economy of private management. In large undertakings, such as rail-roads, canals, water-works, &c., where there are many proprietors, a Board of Management is indispensable, and affords the best guarantee for the interests of the shareholders being attended to; and for such purposes a public company is a public good, as it guards against the inconvenience which would arise by the failure of an undertaking from want of capital or the stoppage of it from caprice. In such projects the competition is trifling and profits regular; but in the iron trade the fluctuations in price are extensive, the opposition to contend against considerable, and the ability and enterprise of the competitors much greater than a public company, however constituted, can ever expect to command.

One cause which operates against the great increase in the number of iron works, is the indispensable necessity of their possessing certain local advantages which are not always to be attained; and without which it is in vain to hope for profit except when the commodity made is saleable at its maximum price; for the great quantity of minerals used in the production of iron, imperiously demands the readiest and cheapest mode of obtaining them, and of carriage to and from the furnaces.

Of the total quantity of iron made in this country, one-third consists of foundry iron, and the remainder is made into malleable iron. The quantity of minerals which are used for making one ton of foundry iron, is about nine tons; and for making one ton of bar-iron of ordinary quality, rather more than fourteen tons of minerals are required; and it is evident, the smallest additional expense on this quantity must form an important feature in the cost of a ton of finished iron. If the quantity of iron made in this country annually be taken at 690,000 tons, one-third being foundry iron and two-thirds malleable iron, the quantity of minerals which have to be raised will be 8,510,000 tons. The great obstacle which would prevent any very great increase in the make of iron at the present time, would be the difficulty of obtaining an additional quantity of minerals, and the very cause which makes the increased demand, opposes at the same

time the greatest obstacle to the supply, by rendering it more difficult to obtain workmen. This is particularly the case with the iron works in some parts of the country at the present time, and is likely to be still further increased when several of the rail-roads now projected are begun, by causing a much greater demand for labour; and the generally improved state of trade, and flourishing condition of most of the great staple manufactures of the country, also tend to prevent an influx of labourers into the iron districts, and oppose an insurmountable barrier to an over production of iron at the present time.

There is one subject connected with rail-roads which, I think, deserves more attention than has yet been bestowed upon it, although it is a matter of considerable importance. Before the Manchester and Liverpool road was made, cast-iron rails were generally used, and the introduction of wrought-iron rails for this purpose was supposed to afford a considerable saving in expense, on account of being so much lighter; now, however, that experience has proved the fallacy of using these light rails,—it being found that the Liverpool and Manchester road must be entirely relaid with stronger rails, and that there is scarcely a rail on the whole line which is not bent or damaged,—it might become a question whether cast-iron rails do not possess advantages superior to the others: for if it be necessary to double the weight of the wrought-iron rails, and consequently the price also; cast-iron rails, which cost the same price per yard, would both wear longer and be more solid, the weight being greater on account of the material being cheaper. There cannot be a doubt as to the greater durability of cast-iron rails, except from their liability to fracture, to which accident they would be more particularly subject in frosty weather; but the probability of this occurring, might be greatly diminished by casting the rails *vertically* and in shorter lengths, by which they would be more exempt from imperfections; perhaps, also, if necessary, they might be subjected to a *proof*, similar to girders for buildings, to ascertain their soundness. It is quite certain that where exposed to oxydation cast-iron will last, *cæteris paribus*, much longer than wrought; and the harder, and therefore the more inferior the quality of the cast-iron, the longer it will resist oxydation. *Hard* cast-iron will probably last three times as long as wrought-iron under similar circumstances, if its ordinary oxydation bears a proportion to its chemical solution, which I consider, from practical experience, to be the case. The experiments of Daniell prove that it takes three times as long to saturate a given quantity of acid with hard cast-iron as it does with wrought-iron; and when steel is used, it requires five times as long to saturate the acid with hard steel, as it does when soft steel is used, and ordinary oxydation will, no doubt, be in the same proportion. If cast-iron rails, therefore, be used, they ought to be made from a hard and strong-bodied iron, for not only would they resist oxydation longer, but the wear by attrition would be diminished in the same proportion.

Though not connected with the practical application of the subject,

it may be mentioned as extraordinary, that, though the power of cast-iron to resist oxydation appears to depend on its hardness, and as it is harder in proportion as it contains *less* carbon, steel should be the reverse of this; for, though it likewise resists oxydation in proportion as it is harder, its hardness increases in proportion as it contains *more* carbon. There is, however, a limit to this; for, if in making cast steel, the metal, while in a state of fusion, imbibes too large a portion of carbon, it at once passes into the state of cast-iron, by which it appears to act agreeably to the chemical doctrine of definite proportions: while, on the other hand, it is probable that in the respective states of cast-iron and steel, the metal is capable of combining with carbon in almost every possible proportion; in soft steel it forms about 1-300th part, and in soft cast-iron about 1-15th part of the weight, the proportions in which it varies between these, being almost innumerable: its maximum seems to be ten parts of carbon to one of iron, which forms plumbago or graphite, commonly known as black lead.

Although but little advance, comparatively, has been made by chemical science in the knowledge of the habitude of iron, the mechanical knowledge of applying it to every purpose of utility and ornament cannot be said to rest under the same disadvantage. The extension of its application has kept pace with the increased production; and to whatever new purpose it has been applied, its superior advantages have been so apparent, that it has never again receded in the public estimation. We need not go back to the period when pins became the substitute for fish bones, or knives and other edge-tools supplanted sharpened flints and similar contrivances; but within a very few years iron has usurped the place of other materials in a multitude of purposes, for which now it is considered absolutely essential. Among these we find water and gas pipes, columns and girders for buildings, chain cables, iron bridges and iron boats, with many others too numerous to mention; but in addition to these, the more important purposes to which it is applied, we cannot turn our eyes to a farm-yard or a park; to a cow-house or a conservatory; to a piggery or a drawing-room; nay, even sometimes to the necks and arms of our fair countrywomen; but we find the almost ubiquitary metal applied to some purpose of ornament or utility. One would almost suppose it to be of *Scotch* origin, for wherever it obtains an entrance it soon supplants all its rivals, and when once it has gained its vantage ground it never afterwards loses it. It has already curtailed the use of wood, hemp, stone, and bricks; and shortly we shall have but little occasion for M'Adam to instruct us how to amend our ways.

Yours, &c. C.

London, March 12.

SOUTH-EASTERN ADVERTISEMENT.

To the Editor of the Railway Magazine.

Sir,

If you think the following analysis of the above advertisment can aid the cause of truth, probably you will give it a place in your next. Q.

"The Bill having passed the second reading, the directors think it necessary to submit a short statement of *some* of the objects and advantages of their plan.

Viz., Such as it is convenient to avow.

"It is proposed to form a railway to connect London with *Dover*, which, whilst it will open a direct and rapid communication with the continent, will also by its central direction, form a main trunk from which branches may be carried to the principal towns in Kent and East Sussex."

For *Dover*, read *Hastings*. [What can our correspondent mean! Is this a sly move to benefit Hastings out of the public pocket, under the pretence of making a railway to Dover? Have any of the directors got property or interests in this sinking watering place?—Ed.]

"The line passes through Croydon and Oxted, by Edenbridge to Tunbridge, thence in a direct line to Ashford, and thence to Dover, approaching Folkstone."

On *paper*, but *can* it *really* so pass to Tunbridge?

"For about forty miles the line is straight and almost level, pursuing nearly the course proposed some years since for the Weald of Kent Canal, for which the late Mr. Rennie surveyed a line which would have been for upwards of forty miles without a lock."

A good level, like charity, may cover a multitude of sins, and the South-Eastern line affords ample scope for the exercise of so heavenly a quality; but a good level is not everything, otherwise the Arabian desert claims a superiority over even the Weald of Kent.

"From Tunbridge, a direct and advantageous line offers for a branch to Maidstone by the valley of the Medway, by which Maidstone would be reached from London in two hours."

No line in *that* direction can be advantageous to Maidstone, while the time of transit is nearly twice that of the direct line, and 240,000*l.* more expensive.

"The promoters of this undertaking are aware of the importance of Maidstone as a commercial town, and they are advised that the true line both to Maidstone and Dover, lies through Tunbridge."

Up to the comma in this paragraph, the "promoters, &c." are no wiser than other people; beyond it, they appear to be *less* so. Do they use the term "advised," because they dread the responsibility of such an assertion as the latter part of the sentence contains?

"Having themselves originally proposed a line to Dover, by way of Maidstone, and carefully investigated the country, they submitted the sections to engineers of the first eminence, who were decidedly of opinion, that the natural obstacles were such as to preclude the possibility of obtaining a good line in that direction."

Mr. Fearon in his sanctified oration at Ashford,* questioned the power of Colonel Landmann to melt down hills of chalk. Has the little solicitor discovered any talisman to which the colonel is a stranger? Can *he*, like music, "soften rocks and bend the knotted oak?" If not, how is it that these same engineers of *eminence* (say rather *anti-eminence*) sanction a line in which the "natural obstacles," are much more formidable?

"They consider themselves, therefore, entitled to state with confidence, that the true line from London to Dover, and that by which the most extensive advantages will be given to Kent and East Sussex, is through the Weald of Kent."

Do they? Unfortunately, however, the question is not what "*they* consider themselves entitled *to state*," but what *the public* consider themselves authorised *to believe*. If carrying a line through a comparatively barren tract of country, and the most barren of the county—where there is nothing to give to, nor anything to receive from—be the most extensive advantages, they indeed have them.

"From Ashford a natural and remarkably level line is found, by the valley of the Stour, for a branch to Canterbury, by which Canterbury would be reached in less than three hours."

By the *direct* line, the time will be reduced to *two* hours, and the distance shortened some fifteen miles, besides saving a quarter of a million of money.

"The terminus at Dover is at a short distance from the pier."

Amounting to just nothing at all, except as proving how hardly they are driven for "*advantages*."

"From the main line communications may, with great facility, be opened with Folkstone, Sandgate, Hythe, Rye, New Romney and the Marsh, Tenterden, Cranbrook, and the towns and districts on and towards the south-eastern coast."

The same facility of communication exists on the northern line, and with places of much greater importance in a *national* point of view.

"There is no canal or other water-carriage through the Weald of Kent."

A mare's nest!!!

"The dissentient owners and occupiers along the line do not amount to more than eight per cent., and even this proportion has been considerably reduced since the return to Parliament."

The preponderance of *assentients* is admitted, but indifference is sometimes mistaken for approbation. The answer given by a man on the

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* I was present at this meeting, and I confess it was with pain and indignation that I heard the observations of this attorney against an absent gentleman; but he had a lesson afterwards, that will, I dare say, teach him to be more cautious in future, especially in what he prints.—Ed.

Birmingham line, that "the House of Commons might * * * * * *" was assumed by the sanguine canvasser to be "*not unfavourable!*" *

"The directors view their plan as one of great national as well as local importance, not only as connected with the county of Kent, but as forming the direct channel of communication with France, Belgium, and the Continent of Europe, by means of the railways which are known to be in immediate contemplation in those countries."

Equally applicable to *any* Dover line, and more especially so to that by way of Rochester, &c. A *direct* channel of communication, too! in which one travels on almost every point of the compass to get at Dover.

REPLY TO THE EDITOR'S REMARKS ON THE MANCHESTER AND LIVERPOOL RAILWAY,

By William Knight, Esq.

[We readily give place to the following letter. Fully sensible of our liability to err, we shall at all times freely open our columns to any criticism on ourselves made in the liberal, generous spirit of our correspondent's letter, and shall leave it to our readers to decide between us. Editor].

19, *Kenton Street, Brunswick Square,*
March 12, 1836.

Sir,

In taking up my pen to address you, I do so with some reluctance, as the subject which I am about to notice may, in one respect, be deemed too trifling to demand such attention; and in another, I may be thought to address you in an invidious manner; but believe me, sir, however we may differ or agree in opinion upon the former—although, since you yourself deemed it worthy of notice, I cannot think that we shall differ much; but be that as it may, I can assure you that you will do me an act of injustice, if you imagine for a moment that an atom of malevolence is in my mind. Had the observations to which I am about to draw attention, emanated from any one not so high in the ranks of science, and so much and so admirably placed before the public, it would not have signified; but in many respects, from your acknowledged merit, your opinion will almost have the authority of a law, and therefore it is, I presume to offer my sentiments as a feeble attempt at a counterpoise, and in accordance with the proverb, "Ogni medaglio ha il suo reverso." I offer your readers the reverse of your position.

* This, it seems, is a fact. A person being asked to give his assent or dissent for the then proposed Birmingham line, refused to give any answer; but it being urged to him that some answer must be given to the Parliament, he replied in the vulgar terms alluded to: "Then tell them to * * *." which it is said was recorded, and being special, was taken affirmatively.
Editor.

The subject to which I will now desire your attention in the first place, is that part of your opening remarks in your Railway Magazine for the present month, wherein you make comparison between the Liverpool and Manchester, and the Birmingham and the Greenwich railways. The comparison which you make, I cannot but consider as rather fallacious; the first mentioned railway being, and having been for a considerable time in full and active use, whilst the last mentioned has but just commenced a partial running, and neither of the latter being in fact as yet finished. You take the last named two as you would the mechanic previous to his beginning work on the Monday morning, and as yet scarcely divested of his Sunday garments, and you compare him to the fellow workman who at the mid-week is labouring with tucked-up sleeves at his profession; we know which is the cleanest; but, shall I ask, which is the richest? He that has worked and is still working, having wages on hand to support his wife and family, or he that has as yet done nothing, and is only preparing to commence? You seem to expect, sir, that the railways must always be in the completest order of cleanliness, and that the sign of their well-being is, when they appear tout au fait, like the miniature ones of Mr. Salter the modeller; but now, sir, for my own part I cannot but consider that such an appearance is entirely contrary, and incompatible with the interests of the Company to which they belong. Whenever I enter a manufactory—and as such I think the lines of railways may be well brought into comparison, the one place creating, and the other conveying and distributing the created—I do not expect to see every thing in the state I like to see my own sitting-room in. I look for business, for activity on every side, and do not much heed aught besides the completion of the work engaged in; but, sir, if I go into a warehouse or shop where the finished materials are kept for sale or show, the case then undergoes an alteration, and I certainly expect to see a most clean and orderly appearance, that not a speck may appear to sully; but we cannot, I think, expect to see railways like this; as well might we expect to see Fleet Street or Cheapside like the carriage-ways in Windsor Park.

You follow the above-noticed remarks, by animadverting upon the faces of the men engaged upon the railway: and here again we differ; I feel confident that you cannot find a man in their situation, I mean a real practical man, one who hesitates not at putting his hand to any part of his occupation, that be he ever so clean in the morning of his day's work can possibly keep himself so for any length of time. Unless he be prevented by pride, foolish ignorant pride—if he would do his duty in that situation, he cannot always be clean. And what, sir, is the sign which demonstrates itself, upon this reflection? Simply, that from this very dirt, or defilement, call it as you will, of which you complain, proceeds the means of their existence—their very comforts spring from it—every parcel of dirt provides for them a meal of substantial food, and the streaks marked by perspiration upon their faces, are channels which convey to them

draughts of refreshing beverage. I think, sir, we should incline ourselves to look at the origin of your complaint in this instance, much as we look at the heap which is about to be carried into the field for manure; there is a necessity for the smell and the appearance which offend the delicate organs, but let us consider for an instant, and we shall find that the golden grain which springs from it, counterbalances by far the offence it gives to the nose and the eye: so with the railway and the men employed thereon; the very Anti-Bond-Street appearance of them which offends, is the source of the immense advantages which we derive therefrom, and without the former trifling evil, we cease to reap the latter sterling good. It is impossible in such employments to have the working men put up in millinery style, and kept in a band-box, as it were, and I think your remarks will rather tend (and it is upon this hint I speak), being so public a censure upon them, to induce the men, who at present are heedless of their dinginess of appearance, and only anxious for the well-being of their work, to be more saving of the former, and less so of the latter. You must not imagine, sir, by these remarks, that I do not like to see men cleanly, as my feelings are quite contrary to such a supposition, and I am in fact and truth an advocate for the infliction of some punishment on every man who does not appear cleanly at his work in the morning.

I have a few more remarks to make, sir, and I perhaps ought to apologize for engrossing so much of your time.

We cannot for an instant but believe that you, being convinced of the benefits to be derived from railways by the commercial world at large, are favourable to them in general; and that you would not wantonly urge any thing upon public notice, which might convey any either direct or indirect injury; yet I certainly think, nor, what is the material import, am I, I am confident, single in my opinion, that your remarks respecting the impression made upon you when ascending the Whiston inclined plane, are calculated to create a feeling prejudicial to railways in general. Many, by your description, may picture to themselves the passage as a most frightful one. You describe the engines as imps of torture from his Satanic Majesty; why not rather portray them as beneficent genii, who have come forth from their dwellings of thousands of ages to shower their blessings upon the earth and its inhabitants: the four elements, the water, the earth, the air, and the fire, have all sent their spirits, and all are combined by the same kindly feeling to render their services unto the Lord of the creation, for their sole benefit.

I shall not longer trespass, sir, but conclude by assuring you that I am equally an admirer of your quoted line as yourself; but I trust, and I do so because I am also with yourself a well-wisher to the shareholders of the Companies alluded to, I trust that ere long, when seeking for the maiden bloom upon those railways which you admire, we shall find it chased away by the multiplicity of traffic, and ourselves left to exemplify it, in the words of the poet, "Heu quove fugit Venus? Quove color decens?"—HOR.

Returning you thanks for the talents you have devoted to the cause of railways in general, and the ability you have displayed in introducing the science more fully to the world,

I remain, Sir, yours, &c.
WILLIAM KNIGHT.

To John Herapath, Esq.

THE BRIGHTON RAILWAYS.

MR. GIBBS'S REPORT.

PROBABLY no subject has so much occupied the attention of the rail-road public of late as the rival lines to Brighton. Not less than six were some time since in the field at once—one by Sir John Rennie, a second by Mr. Vignoles, a third by Mr. Cundy, a fourth by Mr. Gibbs, a fifth by Mr. Stephenson, and a sixth by Mr. Palmer; to which might be added the wild whims of some others that hardly arrived to a name before they died. At length the first two ceased to exist; Mr. Cundy's, through sheer mismanagement, got hid under a cloud, and there only remained before the public the three last. Among these the fight was expected to be, when all at once Mr. Palmer turned off from going to Brighton to Dover, and left Messrs. Stephenson and Gibbs to contend for the victory. Scarcely was this known to the public, before Mr. Gibbs, owing to some irregularity or neglect, it is said, on the part of his subalterns, found himself so involved in dilemmas from non-compliance with the standing orders of Parliament, that his committee thought it needful to withdraw their intentions of going for a Bill the present session, and Sir John Rennie sprang up again to contest the point with Mr. Stephenson. In this Bobbin-Joan sort of style it is that things have been going on with the Brighton lines, and such is the state in which they at present stand.

That there should be jobbing in matters out of which so much is to be got, is natural to expect; it would be almost un-English if there was not. But if there be any truth in the insinuation thrown out in the following extract from pages vi. and vii. of the preface to Mr. Gibbs's Report, all that we can say is, that it is a monstrous confederation, a conspiracy against the public weal, that deserves the severest reprehension, and we hope will be thoroughly sifted before Parliament.

"I have now before me an advertisement by which it appears that an alliance has been formed between the Southampton, Mr. Stephenson's Brighton, and the South-Eastern Railway Companies.* I would hope, for

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* The line called the South-Eastern, and of which Mr. Palmer is the engineer, was brought out as a Brighton and Dover line; but it appears by this alliance, that the intention of going to Brighton is now abandoned, in order, by that means, to obtain a reciprocal transfer of interest.

the honour of all parties, and especially on account of the respect due to the legislative body, whose task it will be to sit in judgment upon this question, that the 'mutual co-operation and support' announced in this advertisement is not intended to overthrow, without ample investigation, every other project which has a similar object in view; yet I cannot help feeling that this alliance is formed for the purpose of obtaining an undue influence. I rely, however, on the justice of Parliament to decide, whether bodies having no common union of interest, except that produced by mutual co-operation, shall use their united influence to extinguish their opponents."

After an outline of the history and progress of these railways, Mr. Gibbs proceeds to describe the particular routes of each, together with the general features of the country. As this may be of some interest to our readers, we shall extract it at length, leaving any remarks to a future opportunity.

SIR JOHN RENNIE'S LINE.

"The line proposed by Sir John Rennie commences at Kennington Common, and proceeds through Brixton to Streatham Common, crossing the Brixton-road near Loughboro' House, and passing within a quarter of a mile west of the church. From Streatham Common, the line gently curves down to the barracks at Croydon; whence it runs along the west side of the town, passing through the grounds of Hayling House, and then proceeds in nearly the direction of the Oldham Road to Merstham. Passing along the east side of the latter town, the line again curves by Wiggy Farm, Redstone Hill, and Little London, to Earl's Wood Common; crossing which, it proceeds in a nearly direct line through Horley, Tensley Green (at which place it crosses the county boundary), and Hazlick Mill to Cinder Banks in Tilgate Forest; then a very gentle curve carries it through the forest to Northland; whence it runs in a straight line by Bigg's Farm, Slough Place, and Cuckfield Place to Bishopstone, leaving Balcombe and Cuckfield on the east, and Slaugham and Bolney on the west. Beyond Bishopstone the line assumes a shaper curve, running close to Dumbrel's Farm, Cobb's Mill, and Langton, and through Hurstperpoint to Danny, the grounds of which it divides, and then passes in a slight curve by Wolsonbury Beacon and through Pidcombe to Patcham. South of Pidcombe, this line and that of Mr. Palmer cross twice, then run parallel through Patcham, diverging as they approach Withdean; from which place Sir John Rennie's line proceeds through Preston to Brighton.

"The distance by this route from Kennington Common to Brighton is 47 miles and 24 chains. The character of the gradients upon the line is 9 miles 16½ chains level; 1 mile 22 chains rising from ten feet to fifteen feet in a mile; and 36 miles 65½ chains rising from fifteen feet per mile upwards. The quantity of earth-work upon the line is 176,144 cubic yards per mile; and it will have four tunnels, the united length of which will be 6165 yards.*"

Mr. Vignole's and Mr. Cundy's lines—the one from abandonment, and the other I cannot say from what—being out of the field, are not considered; neither is Mr. Palmer's, which is turned off to Dover.

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* Tables containing the *details* of the gradients and cuttings and embankings, together with the rises and falls upon each line, will be given in our next.

MR. STEPHENSON'S LINE.

The line proposed by Mr. Stephenson, commences at the Southampton railway, five miles and a half from its Vauxhall terminus, proceeding in a curve to the west end of Merton; thence it runs through the eastern corner of Cannon Hill Park, and skirts the western side of Mordon Park through Lower Mordon, when it again curves towards Park Farm; and thence runs parallel to the turnpike road in a nearly straight line close to Ewell and Epsom, and along Epsom Common to the Ashstead and Kingstead road, which it crosses about a quarter of a mile south-west of Duke's Hall. The line then again curves toward Leatherhead, skirts the eastern side of that town, and enters the vale of Mickleham, through which it runs in a slight curve, crossing the road from Leatherhead to Dorking twice, and the river Mole thrice. At the Punchbowl public-house, about half a mile east of Dorking, the line crosses the road from that town to Riegate, and proceeds between the grounds of Betchworth Castle and Chart Park, by way of Brockham Common and Ewood to Newdigate; thence in a curve to Taylor's Farm, having Green's Farm, Capel, and Rushel Farm on the west, and Temple Farm and Tanhouse on the east. From Taylor's Farm, the line pursues a nearly straight course through Warnham to Lake Barn, passing the county boundary about one mile and three quarters west of Rusper; it then proceeds in a curve to Farthingbridge; thence in a straight line, with Horsham about one mile to the east, and Itchingfield about one mile to the west, to near Southwater, when it again curves to Cob's Hill; and thence curves in a contrary direction to Smallham. From Smallham the line pursues a direct course to Stretham Farm, crossing the river Adur near the point where it divides; then gently curves toward Beeding Court, from which place it keeps nearly the course of the Adur, passing through Old Shoreham along the site of the barracks at New Shoreham, and through Egypt to Southwick; whence it proceeds between Coppard's Gap and Aldrington ruins to the back of Hove Church, where it divides itself for the two Brighton termini; one of which is at the cross roads west of New England Farm, and the other a little east of the Chalybeate.

The distance by this route from the Southampton railway to the dividing point at Hove, is 48 miles 54 chains; thence by the north terminus 1 mile 54 chains, and by the southern terminus 74 chains; making the aggregate lengths between Vauxhall and Brighton, respectively, 55 miles 8 chains, and 55 miles 68 chains. The character of the gradients upon this line, exclusive of the portion of the Southampton railway made use of, is as follows: 10 miles 10¼ chains level; 5 miles 12 chains, rising from five feet to ten feet per mile; 10 miles 13 chains, rising from ten feet to fifteen feet per mile; and 25 miles 66½ chains, rising above fifteen feet per mile. The quantity of earth-work upon the line is 138,374 cubic yards per mile; and it will have four tunnels, the united length of which will be 2244 yards. If the southern terminus only be adopted, one of these tunnels, 990 yards in length, will be avoided.

MR. GIBBS'S LINE.

THREE routes have been surveyed by me for the purpose of continuing the Croydon railway to Brighton, and which may be respectively designated the Merstham, the Betchworth, and the Leatherhead lines; the two former having each a branch into the Southampton railway, for the convenience of passengers wishing to go to the west end of London. The line distinguished as the Merstham one, commences at the terminus of the Croydon railway, and proceeds in a nearly straight line by Duppa's Hill, Beggar's Bush, and Old Brewhouse, where it crosses the turnpike road, to a point about three quarters of a mile west of Coulsdon, and then runs in a curve to Aldersted Heath; from which place it pursues a very gentle curve, nearly in the direc-

tion proposed by Sir J. Rennie, passing close to the lower part of Merstham, Frenches, and Little London, and across Earl's Wood Common to Partridge Wood Common. From Partridge Wood Common the line curves to the west, passing Heavywood Farm to Lodger's Farm; whence it proceeds in a straight line, skirting Norwood Hill to Cudwort; and then gently curves down to Taylor's Farm, where it is met by the line proposed by Mr. Stephenson; and about a mile beyond which it crosses the county boundary. From this point the line proceeds parallel to the road from Capel to Warnham, curving eastward as it approaches the latter town, down to the road from Horsham to St. Leonard's Forest; from thence it pursues a straight line, bearing nearly due south, through Coldstaple, Courtup Hill, close to the east corner of West Grinstead Park, and through Loyts, to about a quarter of a mile east of Ashurst. The line then bears a little to the east, through Greenfield and King's Barn to Bramber; then curves through Botolphs, crosses the river Adur, and passes through Old Shoreham to Kingston-by-Sea; and from thence it proceeds by the southern part of Southwick, and Coppard's Gap to Hove, when it bears northward to the terminus, near the site of the Old Beast Market, Brighton. The western branch line runs in a curve from Duppa's Hill, crosses the Wandle, and then taking the direction of the old tram-way by Mitcham Common, Jacob Green, and Merton Mill, falls into the Southampton railway near Garrett Green, three miles sixty-four chains from Vauxhall. This branch has also a diverging one to the Southampton railway southward, near Combe Lane, thus giving to that railway the advantage of a city terminus.

The distance by this route, from the Croydon railway to Brighton, is 45 miles 73 chains; and from the Southampton railway to Brighton 51 miles 63 chains: making the distance between Brighton and the east and west ends of London respectively, 56 miles 44 chains, and 55 miles 27 chains. The character of the gradients upon the Merstham line is 35 miles 44¼ chains level, or rising not more than 5 feet per mile; and 10 miles 28¾ chains of inclined plane, varying in inclination from 28 feet 6 inches to 52 feet 3 inches in a mile. The westward branch has 3 miles 56¼ chains of inclined plane rising about 30 feet in a mile, the remainder being level. The quantity of earth-work upon the line will be 156,816 cubic yards per mile; and it will have two tunnels, one of which will be 3003 yards, and the other 1309 yards in length.

The Betchworth line commences at the same point as the Merstham line, diverging westward at the river Wandle: thence it proceeds in a nearly straight line, running parallel to the south side of Carshalton Park, to the site of the old windmill on Banstead Downs; it then curves to Sutton Lodge and Hare Warren, when another curve carries it along the upper edge of Woodcot Park, west of the race course, and through Little Hurst Wood to Great Hurst Wood. From this point, the line proceeds in a straight course through Piblane Farm and Hoppers to the river Mole, a little south of Moor Place; whence it bears to the west over Gadbrook, Dun, and Shelwood Commons, until it is met by Mr. Stephenson's line at the south skirt of Ewood. The line then bears a little more to the west, passing through the north part of Newdigate, Green's Farm, and Rushel Farm, until it falls into the Merstham line at Taylor's Farm, following from thence the same course to Brighton. A branch may be carried from Sutton Lodge on this line by Mitcham to the Southampton railway, near Garrett Green, the length of which branch would be seven miles.

The length of the Betchworth deviation is 20 miles 64 chains, while the distance between the two points of the Merstham line from which it diverges is 19 miles 40 chains; making a difference of a few chains between Brighton and London Bridge in favour of the Betchworth line, but against it between Brighton and Vauxhall. The character of the gradients, and the quantity of

earth-work and tunnelling upon this deviation, is nearly the same as upon the corresponding distance of the Merstham line.

The Leatherhead line is merely a branch from the Croydon railway to Leatherhead. It leaves the Betchworth line near Carshalton Park, the southern corner of which it crosses; then proceeds to the lower part of Sutton, Cheam, and Ewell, whence it passes through Epsom, across Epsom Common, &c. and through Ashtead to Leatherhead Common Fields. The length of this branch from the Croydon railway to Leatherhead is 11 miles 55 chains, nearly the whole distance being level.

The line previously stated to have been relinquished by the Croydon railway Company, in consequence of its interference with much ornamental property, was a continuation of this Leatherhead branch by way of Mickleham, Dorking, Capel, and Horsham, forming a perfectly straight line until it reached Steyning, when it bore to the east through Botolph's, Old and New Shoreham and Southwick to Brighton: and it may be here observed, that the amount of earth-work upon this perfectly straight line would amount to no more than that upon the one now proposed by Mr. Stephenson.

(To be continued).

THE SOUTH-EASTERN DOVER LINE OF RAILWAY.

To the Editor of the Railway Magazine.

Sir,—In this rage for railways there is scarcely a place in England of any consequence but has one or more lines of railroad projected, for the good, of course, of the good people of the towns to which they are intended to go.

A foreigner reading our railroad prospectuses, would surely imagine us to be the most mad, or the most patriotic people on the earth. Like Paddy's potatoe in a ten-acre field, our railroad virtue or phrenzy is grown so monstrously large, as to thrust every other good and bad quality over the hedge. Million after million are asked for and subscribed, as if they were so many French sous or centimes. However, these projects have an impetus now, which nothing can stay; but it is amusing to trace the eagerness and zeal with which they are followed up. If the ailing, the lazy, the idle, or the profligate congregate at any particular place, our wonderful politeness instantly projects a railroad for their comfort and accommodation. The soft dumplings and sausages of Norfolk, the cows of Suffolk, the calves of Essex, and the clotted cream of Devonshire, are all equally to be provided for at the trifling expense of some eight or ten millions. Nay, with such zeal do we proceed in our charming career, that three several companies with as many different lines, and four or five millions to boot, a little time since were actually contending for the honour of bringing to London the herrings of Yarmouth! Yes, indeed, and poor Taffy himself, that St. David's day may not see him without his leek in his crown, fresh from the land of "true Britons," is not to be left out. Can we therefore feel wonder, having railroads to the north, the south and the west, that our kind feelings should extend to the east, and that a brace of railways should be projected to bring the birch-twigs of Kent, for the purpose, we presume, of keeping young Cockneys in order?

As these lines are now become the subject of Parliamentary investigation, it will not, perhaps, be amiss if we enter a little into their history,* before we review either—and we shall begin with the accuracy of solicitors'† statements.

In May, 1834, a prospectus was issued by the solicitors to the present South-eastern line, containing proposals to form a line of railway, of which Mr. Green was the secretary, and Colonel Landmann the engineer. It was to be a continuation of the Greenwich railway, on the advantages of which they glorified themselves not a little. Six months after the same solicitors sent forth another prospectus, retaining, I believe, Colonel Landmann, but replacing Mr. Green by a Mr. Yeats. And here it is worth while to pause a little, for the purpose of considering the statements of this new prospectus. They now informed us that a survey had been made; that the line is to pass through Greenwich, Woolwich, north of Dartford to Greenhithe, by Swanscombe, south of Northfleet, near Gravesend, between Camer and Sole-street, by Dallison's covers, Snodland, near Maidstone, thence straight on through Hollingbourn, Charing and Ashford, to Cheriton, and afterwards to Dover, with a branch to Folkstone—that is the exact route taken by the present Gravesend and Dover companies. This is deserving attention from what afterwards follows. The solicitors, like men good and true to truth and the public interests, tell us that they have "delayed the publication" because they were "desirous of *verifying* as far as possible the estimates of income on which they proceed." This was very kind and very proper caution. Men should not send forth crude, hasty statements; and having done so, they *now* tell us "they bring them forward with *confidence*, being satisfied they *are not overstated*."

I confess I was mightily pleased with this: it looked well, and the solicitors rose some hundreds per cent. in my estimation. But being somewhat fond of calculations and not inclined to take things on trust, I tried one or two of them for amusement. The first that attracted my attention was that of the coaches and vans. These gentlemen tell us that there are "143 coaches and vans licensed for the conveyance of passengers," which "perform 99,630 journeys in a year, and are capable of carrying (if all were full) no less than 5,543,200 persons." (Prospectus, page 2). Now having divided the number of persons by the number of journeys, I found to my astonishment that each coach must be "capable of carrying" every single journey no less than 55 persons, and near $\frac{64}{100}$ of a person!!! Astounded at this, I mentioned it to a gentleman. "O!" said he, "this is nothing, I have gone into the calculation of their barges and tonnages, and I find that each vessel must carry not less than 1540

* The Gravesend line having by SOME means been thrown out of Parliament, for the present Session, the historical part of it has been merged into that of the South-eastern line.

† These gentlemen seem to be almost the only constant quantities in the prospectus.

tons a time, or if not, must perform upwards of six voyages per day throughout the year, including Sundays, to and from Maidstone to London." Really these dear solicitors beat Gulliver and Munchausen to nothing. The iteration too of their claims to public confidence in their statements, equals if not surpasses that of the renowned heroes they appear to imitate. It is the Alpha and Omega of their prospectus. They begin with telling us that having verified, as far as possible, their estimates, "they now bring them forward with *confidence, being satisfied they are not overstated;*" and they conclude with this bold challenge to scrutiny; and further demand on public credulity "to rely on the facts and figures *which they can produce and verify,*" (I should like to see them), "rather than on arguments," having, as they assert, "*satisfied themselves that their calculations will bear the strictest scrutiny.*"

Now, after such a proof of absurdity and misrepresentation, in a statement sent forth with such solemn and repeated assurances of accuracy, I leave the quantum of confidence to be placed in the printed documents aud asseverations of these clever solicitors, to others to estimate.

But let us proceed with our history. Finding I suppose, or imagining that the invalid visitors of Brighton stood more in need of rapid conveyance than those of Kent, or thinking that it was likely to be a more profitable speculation, the solicitors abandoned their Dover line, though they distinctly stated they were *determined* to proceed with it, and turned their kind attention towards the fashionable Brightonians, hooking on another engineer, Mr. Palmer, instead of Colonel Landmann.

At length a strong gale having sprung up from the west, by Stephenson and Rennie, they once more veered round towards Dover, having changed their metropolitan terminus from Greenwich to Kennington Common, from Kennington Common to Wandsworth, and lastly from Wandsworth to Croydon. Nothing indeed can have exhibited greater fluctuation and uncertainty than even this very Dover line. At one time it goes through one place, at another through another. Today it is intended to run through Tunbridge Wells, tomorrow through Tunbridge Town, but the next day no one knows where. There seems in fact to have been but one thing steady—the determination to partake of the good things of a railway line; and to this it must be acknowledged the parties have stuck with unflinching pertinacity. We shall now proceed to shew with what judgment.

The line, as it now stands, commences from Croydon—I presume from Church-street, where there is a branch to the intended Croydon railway. The starting point is at an elevation of 22 feet above the street, and the line proceeds on an embankment averaging about 27 feet high, for a distance of two miles. For 1·14 mile from the terminus the line rises 35·2 feet a mile, a tolerably decent up-hill beginning. For another mile and three quarters it then springs up to 52·7 feet per mile. We are now arrived about 130 yards in a

tunnel of ·285, or better than a quarter of a mile long, and as it appears to me, in about the sharpest part of a curve of three-quarter mile radius. Beyond this, the line rises 1·19 mile at 34·5 feet per mile; then 0·71, or near three-quarters of a mile, at 18·6 per mile; and two miles farther at 15·5 feet per mile. This attains the summit 217 feet above the starting point.

From the summit the line begins to fall for 1·85 miles at the rate of 16·3 feet per mile, passing through a tunnel upwards of 1½ mile long. Its next plane is 1·64 mile, falling 52 feet per mile, which reaches the abandoned branch to Brighton. It then goes on for 8·55 miles, falling fifteen feet per mile; for 3·32 miles, falling 10·6 feet per mile; for 2·68 miles falling ¾ foot per mile; and then for 3·78 miles falling 12·2 feet per mile. We have now 1·46 mile level; 3·13 miles rising 2·9 feet per mile; 2·98 miles falling 0·3 feet per mile; 2 miles level; 1 mile rising 6·9 feet per mile; $\frac{11}{100}$ mile rising 27·3 feet per mile; 7·69 miles rising 8·2 feet per mile; 1·10 miles rising 0·9 feet per mile; 1·56 miles level; 2·99 miles rising 12 feet per mile; 6·51 miles rising 14·8 feet per mile; 1·56 miles falling 52·6 feet per mile; 1·89 miles falling 16·5 feet per mile; 5·62 miles level; and then 0·95 miles falling 31·6 feet per mile to Archcliffe Fort, Dover. Near this end is the third tunnel of two miles, making in tunnelling altogether about four miles; and adjoining Folkstone a curve of three-quarter mile radius.

These are the gradients of the line, which passes by the little towns of Oxtead, Tunbridge, Tudeley, Marden, Headcorn, Ashford, Stamford, Newington, and Folkstone. Beneath is a table of the times of traversing each way, and on a level. It contains various planes grouped together, assuming 24 miles an hour as the velocity (the Liverpool and Manchester limit) that can be safely used in descending planes beyond a certain declination.

TIME OF TRANSIT IN MINUTES, SUPPOSING THE VELOCITY TO BE THIRTY MILES AN HOUR ON A LEVEL.

Distances in Miles.	From Croydon.	From Dover.	On a Level.
6·78	33·29	16·95	13·56
12·04	30·10	46·17	24·08
9·78	24·45	27·11	19·56
21·10	49·65	34·75	42·20
9·50	37·00	23·75	19·00
3·45	8·62	17·17	6·90
5·60	11·24	11·24	11·24
0·95	2·37	4·63	1·90
69·22	196·72	181·77	138·44

Hence it appears that the times of transit are 3 hours 17 minutes from Croydon to Dover, and 3 hours 2 minutes back again; the

time on a level being 2 hours 18 minutes. So that the line, notwithstanding its boasted length of level—which, however, is no where to be found, except in the speeches and assertions of its advocates—would actually require one hour all but one minute longer in going to Dover (on 2 hours 18 minutes) to traverse it than if it was a level, and three-fourths of an hour greater in coming back. That is, the velocity, supposing it to be 30 miles an hour on a level, would be reduced to little better than 21; and if it was 20 miles an hour (the present rate of travelling on railways), to 14 in the passage from Croydon to Dover. What possible advantage could this be for so enormous an outlay? The load to be carried, which is always to be determined by the most difficult plane, would fall short either way 70 per cent. of a full load on a level; or be under three-tenths of a load. The expense of carriage, too, would cost the company about 40 per cent. more than if it was a level line; so that in any and every way it is equally disadvantageous.

The population of all the towns and villages within three miles of this line—exclusive of the two termini towns, appears to be under 78,000; while on the rival line, within the same limit, and with the same exclusion, it appears to be about 300,000; the latter line passing through places of great wealth and trade, and the former through a country in which towns are strangers and the villages puny exotics. It is very sapiently argued, that the line nearly bisects the county: so it may; but does not almost all the population lie on the north? and who is it wants the means of intercourse with the capital but the trade and the inhabitants of the county? It would be about as wise to talk of making a railroad through the sandy deserts of Zahara to benefit the inhabited parts of Africa, as to make a railway through the wild marshes of Kent to be advantageous to the trade and population of the county.

Let us now stop a little to look at what we have accomplished. In less than the three first miles, we have clambered up 130 feet, averaging upwards of 43 feet per mile. And within about $6\frac{3}{4}$ miles, we have actually risen 217 feet, making $32\frac{1}{4}$ feet per mile. This is what may be called good work, exceeding that, I believe, of any passenger railway with locomotives hitherto projected. It may, therefore, with propriety be called the Aspiring or Transcendent railway. One would not like to ask the engineer, how or where he gets the material for the tremendous embankment he begins with, because from the section it may be a delicate question, rather difficult to answer; and it is uncharitable to puzzle a man in difficulties. However, one cannot but admire other parts of the matter. The line begins on a lofty embankment, for the purpose I presume of giving our Londoners an airing, and enabling them to view the surrounding scenery, if there be any. Due regard has also been had to their nerves; for instead of dashing off at 30 miles an hour, our projectors take care to make an incline that will not allow them to exceed $11\frac{1}{2}$, somewhat better than $\frac{1}{3}$ of it. And when they approach the cuttings, the velocity sinks to about 9 miles an hour, a very un-

railway speed it is true, but perhaps intended for the purpose of affording time to the curious to examine the geological structure of the deep cuttings they pass, and to save the nerves of young ladies from the shock of entering too suddenly the tunnel under Riddlesdown.

For what purpose the inclined plane, after getting a little way in the tunnel, changes from 52·7 feet per mile to one of 34·5 feet, I acknowledge I am unable to discover; but doubtless there is some good reason for it, for such a combination of engineering wisdom is here displayed as never yet fell to the lot of a single individual.* It is on all hands now allowed, that a tunnel should never be had recourse to if it could be avoided, because of its excessive nuisance. An inclined plane too, should be shunned, particularly if above 22 feet to the mile, because of its difficulty in going up, and danger in coming down. A curve is objectionable on account of the great friction it occasions, and if less than a mile radius because of the danger in high velocities; but a sharp curve in a steep inclined plane, is so surpassingly bad, as never yet to be thought of. Here, however, we have something more. We have first a tunnel in which there are two inclined planes, the least being 34½ feet per mile, and to crown the whole a curve of ¾ of a mile radius. Thus have been united nuisance with difficulty, and difficulty with danger, not neutralizing, but heightening and increasing each other to the utmost by their combination, like so many wicked conspirators.

So unaccountably odd does all this appear, so pre-eminently absurd, so unlike any engineering principle perhaps ever yet heard of, that I am inclined to believe it never could have emanated from the engineer; it must be the concoction of some other individual. Mr. Stephenson, in evidence given last year in the Lords, said that engineers were sometimes not consulted at all; that a line was laid out by parties, and the engineer ordered to execute it. This surely must be one of those cases; for no engineer would ever think of laying out a line, in which every difficulty and objection to which a line can be subjected, shall be found not separated, but united. Who would ever project a line to increase the time, expense, &c., 146 per cent. in the first 6¾ miles? Who but would laugh at the idea of a railway, whose essence and quintessence are celerity, which, if the rate on a level was thirty miles an hour, must creep along at 12·2 miles per hour for many miles in continuation; and if the speed on a level was twenty miles an hour, the ordinary speed on the Manchester and Liverpool line, the mean rate must be 8·1 miles per hour, a rate which every one knows is far inferior to that of stage-coaches in general? Who besides one who has some object of interest in view, some particular party or place to benefit,—I never said Hastings, St. Leonards, or Tunbridge—would think of carrying

* The intention here is not to censure the engineer, who, there are whispers abroad, never laid out the line; but was ordered to find the best he could in such and such a direction, embracing such and such points.

a line of railway through places in a state of little better than semi-barbarism, with comparatively little or no population to benefit the railway, or be benefited by it; and leave places of about four times the population, in a high state of civilization, from which the greatest advantages would be derived to the railway, and on which it is not problematic, but certain, from the experience of years, that the line of railway would confer incalculable benefits? To me, it appears like attempting to realize the fable of the Belly and its Members, or like endeavouring to transfer the seat of life from the heart to the tail of one's coat.

Anomalies to every thing yet known, abound so plentifully in this line, that it would be a task indeed to go through them all. The idea of making the two termini steep inclines, in which it may happen that the time of getting up the velocity may be doubled, quintupled, or centupled, is as novel in sound engineering principles as it is unfortunate, uneconomical, and injurious; but the side confession of the formidable nuisances of their tunnels, by the talk of making some new-fangled thing under the name of a "Gallery" in their two-miles tunnel near Dover, is somewhat amusing. How this is to be done in a hill whose section is given as varying generally from 250 to 300 feet above the bottom of the tunnel, is cautiously concealed in the deposited plan, lest perhaps this gem of an idea should be stolen and patented. Occasionally however, a bit of the great secret pops out its head or its tail, as if too large to be much longer concealed; and we every now and then hear that some holes are to be cut—a furlong or two through?—in the sides of the hill to the sea, from which light and air are to be distributed, free of expense, to the poor half-smothered creatures within. Doubtless the smallest donations of fresh air will be thankfully received; but as to light, we fear even the kind liberality of the projectors will be exerted in vain. For, what but flash upon flash, like lightning in a dark winter's night, will mock and torment the pitiable wretches, injuring their eyes, and furnishing jobs to some half-famished occulist?

The new line from Deptford to Dover, I am waiting to see; and will then as freely give my opinion of that, as I have of the South-Eastern. DETECTOR.

ON THE PHILOSOPHICAL PRINCIPLES OF HEAT, APPLIED TO DOMESTIC PURPOSES.

(Continued from page 18 of the last Number).

WE have abundant evidence to prove by what has been already stated, that hot-air stoves of all kinds must be exceedingly injurious to the health. However unimportant the effects may at first appear, the consequences of continually breathing an atmosphere in which the quantity of vapour has materially either increased or diminished beyond its natural state, would be to produce pulmonary consumption in any person who had even the slightest predisposition towards that complaint: and on all persons, even the most robust and healthy, its evil tendency would, sooner or later, most certainly be felt: the effect being, in the one case, to keep the lungs in a constant state of saturation with moisture, and in the other, to weaken them by an excessive

discharge. Dr. Paris is of opinion that one of the most effectual remedial measures which could be adopted in pulmonary consumption, would be to keep the patient constantly in an atmosphere containing an exactly regulated quantity of moisture, by which the transpiration from the lungs would be always uniformly the same: this will likewise apply to asthma and some other complaints; and if attention to this be so important a matter to invalids, it cannot long be neglected with impunity by others.

The bad effects produced by the use of hot-air stoves, probably gave rise to steam being employed for the purpose of affording artificial heat: it is, however, now but seldom used except where the mechanical power of steam engines being required, a portion of the steam is applied to warming the building. Though at one time it was a good deal used for domestic purposes in warming dwelling-houses, and also for conservatories and other horticultural purposes; it now is but little thought of, having fallen into disuse from the danger and inconvenience attending it when not under the care of persons perfectly conversant with its management: but a new method has of late years come into use of employing hot water, circulating through large iron pipes, as an agent for affording heat, which possesses many great advantages. It may be as well, before describing this apparatus, to mention an invention which appears to have been intended to connect the two systems, of steam and of hot water, which however, instead of obviating the main objection to steam, namely, its danger when in unskilful hands, requires for its management a greater knowledge of practical physics than can be expected from those into whose hands it usually falls. When cook-maids seek relief in the delights of philosophy from the cares of roasting and stewing; and Hutton's Mathematics, and Mrs. Somerville's "Connection of the Physical Sciences," shall be found alternating with wine glasses and decanters on the shelves of the butler's pantry; we may then perhaps trust domestic servants with the management of such inventions.

The apparatus now to be described, consists of wrought-iron tubes one inch diameter, screwed together and filled with water; the part which passes through the fire and is called the boiler, consists of the same tubes bent into a coil, and that, together with the tubes which pass round the room and radiate the heat, form one continued pipe, which being filled with water (except a very small space to allow for expansion) is then hermetically sealed. No room is therefore allowed for the generation of steam, but by this means the pressure upon the pipes is immense. It has been stated that these pipes can be made so hot, that one foot in length will give out as much heat as is usually obtained from the same length of pipe four inches diameter, heated in the ordinary way. Let us see the effect of this. Suppose the temperature of the air in a room to be at 40°, and the four inch pipes heated in the usual way are at 200°; there are 160° of heat given off by radiation to the air. The *radiating surface* of the small pipes to the large, being as one to four, therefore the small pipes must give off four times 160° = 640° of heat in the same time as the other pipes give off 160°. To this 640° the temperature of the room must be added, in this instance supposed to be 40°, which makes the required temperature of the small pipes 680°. The great question respecting this apparatus is its safety, as the liability of it to burst increases with the increase of temperature. It is usually supposed an iron vessel cannot be made red hot when it has water in it: this is an error; it is only necessary that the quantity of water be not too large, and if the fire be sufficiently strong the iron will become red hot: but the experiment is highly dangerous, as the expansive force of the water is so immensely increased that scarcely any thing can contain it. The expansive force of steam at high temperatures, may be seen by the following table:

Table of the pressure of Steam, in Atmospheres and in lbs., for temperatures from 212° to 511° of Farenheit, by MM. Dulong and Arago.

Heat in degrees.	Pressure in Atmospheres.	Pressure in lbs.	Heat in degrees.	Pressure in Atmospheres.	Pressure in lbs.
212	1	15	399	16	240
251	2	30	404	17	255
275	3	45	409	18	270
294	4	60	414	19	285
308	5	75	418	20	300
320	6	90	423	21	315
332	7	105	427	22	330
342	8	120	431	23	345
351	9	135	436	24	360
359	10	150	439	25	375
367	11	165	457	30	450
374	12	180	473	35	525
381	13	195	487	40	600
387	14	210	499	45	675
393	15	225	511	50	750

The above table only gives the pressures up to 511° of Farenheit; the experiments on which it is founded were only made as high as 437°, on account of the extreme danger attending them from the probable bursting of the apparatus, and the temperatures above that were deduced from computation. It appears, from calculation, that if the apparatus just described, be heated to 680°, the pressure upon it will be about 150 atmospheres, or 2250 lbs. per square inch. Notwithstanding the assertion of the fact, I am satisfied, leaving danger out of the question, that these pipes cannot be practically worked at this heat; and they can only be brought to this temperature, when the quantity of pipe in the fire is very much larger than that which radiates the heat. In proof of this, it is now found necessary, as I am informed, to employ double the quantity of pipe, and to use a lower temperature. The quantity of pipe at present used in this kind of apparatus, is two feet of pipe one inch diameter, instead of one foot of pipe four inches diameter, when heated on the ordinary plan. Now if, as before, the atmosphere of the room to be warmed be 40°, and the four-inch pipe at 200°, the heat radiated will be 160°. Two feet in length of one-inch pipe, presents 75·40 inches of radiating surface, and one foot in length of four-inch pipe presents 150·84 inches; therefore, the radiating surface of the small to the large pipe is as one to two. To ascertain what must be the heat of the small pipe, $160° \times 2 + 40 = 360$ degrees, which is the temperature required for the small pipe to act as efficiently as the large. By the table, we find that 360° of heat produces a pressure of 10 atmospheres, or 150 lbs. per square inch of surface; and suppose, in an apparatus of this kind, there are 300 feet of pipe employed to radiate, and 100 feet in the boiler, making 400 feet,—which would be about the quantity required to heat a good sized conservatory. If the internal diameter of the pipes be ·6875 of an inch, there will be a bursting pressure on this apparatus of 1,555,704 lbs., or 694 tons; and if the heat could be raised to 680°, as previously mentioned, there would be a bursting pressure of 10,417 tons! The only reason which makes this kind of apparatus safe, even for a single day, is the extremely small quantity of water which it contains, and the small size of the pipes: were these to be four inches, instead of one-inch

diameter, scarcely any thickness or strength of metal could resist the pressure. From employing so small a quantity of water, however, an objection arises, which would not apply if a greater quantity could be used: the degree of heat is so easily altered, that by putting on too large a quantity of coals, or any other cause which produces a fiercer fire than usual, the pressure on the pipes may very soon be doubled or trebled; for if the temperature of the pipes be raised 58°, say from 360° to 418°, the pressure is immediately doubled; and if it be raised 39° more, the pressure is exactly trebled. Now when it is borne in mind that scarcely any *high pressure* steam engine is considered safe, if worked beyond three atmospheres, or 45lbs. per square inch, some judgment may be formed of the safety of this kind of apparatus, the pressure on which appears to be usually 150lbs. per square inch, and may be raised by adventitious circumstances to 4 or 500lbs. or upwards, without any one being aware of it; and we must consider that the strength and quality of the apparatus is constantly degenerating by the erosion of that part which is in the fire, rendering it each day less able to bear the immense pressure to which it is exposed. What was stated as an objection to hot-air stoves, likewise applies to this invention: the extreme heat of the radiating surface alters the chemical properties of the air, and as we have previously seen, materially affects the healthy action of the whole animal economy.

Whatever ingenuity this invention may possess, it is not I conceive, original: the idea appears to have been borrowed from the celebrated traveller Gulliver, who relates that on visiting the academy of arts at Balnibarbi, the Flying Island, he there saw a learned philosopher engaged in extracting sunbeams out of cucumbers, and condensing them into glass tubes which he then hermetically sealed; and with which he proposed to supply any quantity of artificial heat. It is not related what was the amount of pressure used in the condensation, but, notwithstanding the high flown ideas of the Balnibarbian *savant*, I do not think even he would venture to use a greater amount of pressure than our hot water experimentalist: and the '*sun-beam apparatus*' would certainly possess one advantage over the imitation, for no person could say of it that the invention was all moonshine. I do not happen to know the chemical composition of sunbeams, but as we are told by the poet of

"————the liquid sunbeam's brightest ray,"

it would appear that the only difference in the two kinds of apparatus is the substitution of one liquid for another; *water* instead of *sunbeams*; therefore it would only have been justice, to have called this invention "*The Balnibarbian principle of heat.*"

The imitation of nature has been truly styled the triumph of art. In her works we find no violent and catachrestical efforts like this which we have been considering, but whenever we follow her for our guide, in those things which we call our inventions, we seldom fail to arrive at a degree of perfection which, however they may, and must in fact, partake of the imperfections incident to all the works of man, may still hold a proud preeminence over those constructed wholly independent of the guidance she affords.

If we follow, in the system of artificial heat, the plan which nature universally adopts, we shall endeavour to obtain an equality of heat by radiation from a large surface at a low temperature; for we have already seen, that heat radiated at a high temperature, is positively injurious to animal life, by altering the chemical properties of the air. The plan which appears to obviate all objections, most completely, is that of diffusing heat by means of hot water circulating through large iron pipes; a plan so

simple and efficient, that whatever improvements may be made upon it in the course of time, will not, in all probability, in any way effect its principles; but only apply to its universality of adaptation. To describe here, the position of the pipes and boiler of this kind of apparatus would be impossible, as their arrangement is nearly as various as the situations to which they are applied; suffice it to say, the pipes and boiler communicate so as to afford a continued stream of hot water from the boiler to the pipes, which give off, by radiation, the heat they thus receive: the water then returns to the boiler by another pipe, to receive a fresh supply of heat, again to part with it as before. The circulation of the water in these pipes, is much more rapid than would be imagined; it will travel through a length of two or three hundred feet, in five or six minutes, the cause of this action and rapid flow being nothing more than the different specific gravities of hot and cold water.

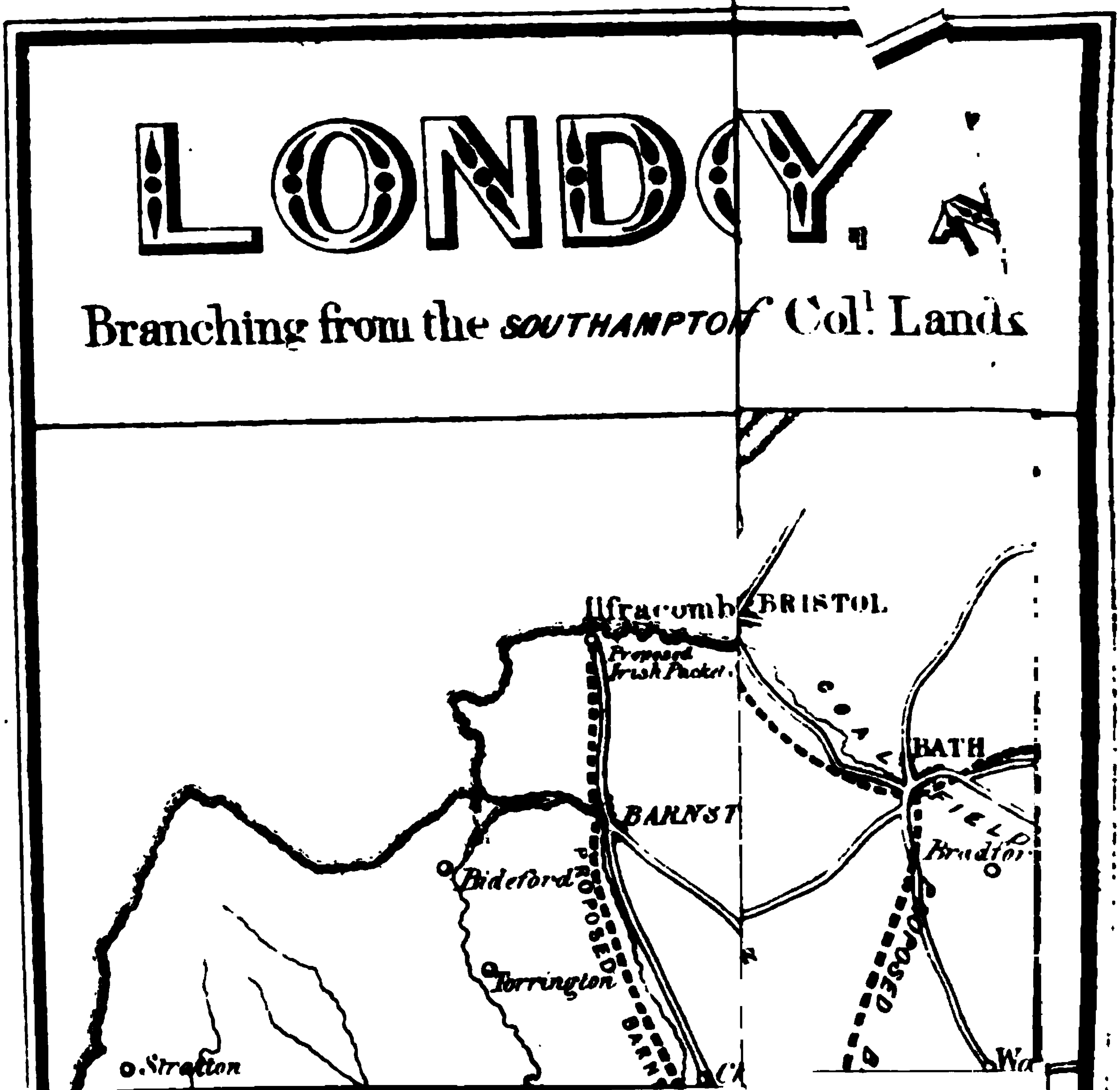
The distinguishing feature of this description of apparatus, is, that it has, at some point or other, a free communication with the atmosphere; and as the temperature of the water cannot rise above 212° while this communication continues, the apparatus must always be perfectly free from any accumulation of steam, and there is, therefore, no pressure upon it *except the actual height of the water*, equal to ½ lb per square inch for every foot of perpendicular height. Its perfect safety in this particular, is therefore a complete contrast with the apparatus last described.

Although I have stated the plan is extremely simple, perhaps that term will more properly apply to the mode of working the apparatus, than to its erection. When once erected, no care or management is required, beyond merely lighting the fire; but its erection, when the situation is such that the pipes cannot be laid level with the boiler, frequently presents difficulties which it requires no little ingenuity to overcome. Its successful application, in many cases, requires of knowledge of Pneumatics and Hydrodynamics, and whenever the plan has failed, it can be traced to an infringement of the principles of these sciences, arising from ignorance of their laws. Those who require an apparatus of this kind to be erected, would do well, therefore, to ascertain, before they have their houses intersected and cut about by the laying down of pipes, that the person employed understands the principles, and has succeeded in similar instances, for it is notorious that, of those who undertake this kind of work, many are totally ignorant of the laws on which its successful application depends, and therefore, though they may by chance go right, chance may also make them go wrong.

The principal advantages of this invention—leaving out of the question its economy in fuel; though even in this particular, its claims to recommendation are not inconsiderable—are first, the amount of moisture in the air is neither increased or diminished by its use; secondly, there is no deleterious gas of any kind generated; thirdly, the vital quality of the air is not the least deteriorated, or its chemical properties at all changed, the radiating surface being of too low a temperature to produce such effects; and, lastly, its perfect safety.

These are not unimportant advantages, when the apparatus is employed to warm dwelling-houses; and where it is used for conservatories, and other horticultural purposes, it possesses peculiar claims to recommendation for its perfect equality of temperature, and for maintaining the heat an infinitely longer time than any other plan. To these, likewise, may be added another decided advantage,—the great durability of this apparatus in comparison with others; for the large quantity of water which is employed, prevents the boiler ever approaching to a temperature which can injure it; and for horticultural purposes the exemption from accident, of the apparatus employed, is particularly important; because the stoppage of its efficient

ɔperation."



employed, is particularly important; because the stoppage of its efficier

working, even for a single day, might cause the destruction of every plant in the building. This consequence appears almost inevitable, when any accident occurs to pipes worked on the high pressure plan; for not only would the plants suffer by the non-performance of the apparatus, but such is the expansive force of steam at a high pressure, that the smallest fissure happening in the pipes would instantly be followed by the rending asunder the whole of that part of the apparatus; the escape of steam completely destroying the plants, and not improbably the building also, by its uncontrollable violence.

(To be continued.)

LONDON, SALISBURY, AND EXETER RAILWAY.

Owing to the late time at which the report of this railway reached us, we are unable to enter into the detail of this magnificent work in the manner we could wish. We shall, therefore, merely make an extract from the *Western Times*, which, better than anything we can say, will shew the favour with which it is regarded by one of the local journals on the line, and therefore the best able to appreciate its merits. Ed.

LONDON, SALISBURY, EXETER, PLYMOUTH AND FALMOUTH RAILWAY.

"This magnificent undertaking is progressing with the speed of a locomotive engine, and such is the conviction in the public mind, of its expedience, utility, and general success, that we are informed applications for shares are pouring in from all directions; upwards of 12,000 shares were taken in a few days at Manchester, Liverpool, Birmingham, and Leeds; Sheffield, York, Glasgow, and Edinburgh, have also eagerly shewn their unbounded confidence in the success of this improved source of national communication by applying extensively for shares.—The government, no doubt, appreciate the advantages they will derive in the conveyance of the mails, troops, baggage, &c., and we understand that to ensure a good working line, they intend sending their own engineers to survey and report upon the line previous to a bill being obtained; but from Colonel Landmann's scientific and practical acquirements, exemplified in the construction of the Greenwich railway, combined with Mr. Charles Dean's local knowledge, this at first sight would seem superfluous, and it only shews the anxious wish of the government to do that which will permanently benefit the country. The railway will run parallel to the city of Exeter, from St. Anne's Chapel to the Depot in the Barnfield, and thence to the New Bason, from whence the lines to Plymouth, Falmouth, and Barnstaple will spring, and will confer advantages on the city of Exeter, which cannot be otherwise than appreciated by the inhabitants at large, and ensure their zealous co-operation."

SITE OF THE ROYAL OBSERVATORY.

The situation of our national Observatory has long been considered anything but eligible for its object by astronomers. A hundred and sixty years ago, when the population of London perhaps scarcely exceeded the present united populations of Deptford and Greenwich, with their neighbourhoods, and when these villages were villages indeed, and London in reality five or six miles off, the situation of the Observatory was good, and probably unobjectionable. But now that the capital, besides stretching immensely to the north and south, has actually marched down to the very doors of the Observatory, and Greenwich and Deptford have extended far round it, with a population exceeding that of many cities, such vast volumes of smoke are wafted over it with westerly winds—that is commonly for seven days out of ten in the year—that little use can be made of the Observatory. Besides, the lofty trees of the Park must tend very much to circumscribe the observations, if they do not indeed actually affect the refraction. Under all these circumstances, it certainly is desirable that the Royal Observatory should be removed to some better situation; and, before many years elapse, there is little doubt but it will. As to disturbing the meridian, any complaint on that score, men of science know to be absurd. But if there was any thing in it, a good situation may easily be found in the same meridian, either north or south of Greenwich Park, within, I think, 20 or 30 miles, which would obviate every thing.

Except the great trouble of re-fixing the instruments, &c. which would fall heavily on the Astronomer Royal, I can scarcely believe the rebuilding of the Observatory would cost more than from 5,000*l.* to 7,000*l.* But this is, of course, little better than guess work, or jumping at the cost.—Ed.

RAILWAY NOTICES AND INTELLIGENCE.

Maps for Railways.

As economy is the order of the day, our attention has been called to a very good idea for saving expense as well as for dispatch in publishing any new line of railway. We have just seen announced, published by Lacey, St. Paul's Church-yard, some steel plate engravings of the county maps, which he proposes to supply to engineers, &c., with their line of railroad laid down, at little more than the price of the paper and printing. We have seen the maps, which are a double royal folio page, containing the hills, rivers, towns, &c., and the roads minutely described; the last having the advantage of being distinguished into mail, turnpike, good travelling, and bye roads, besides other useful information. When a line of railroad, therefore, is laid down on such maps, information and particulars, which it would be impossible to have without great expense, and not then with any thing like the accuracy, are at once presented to the view. Should the intended line pass through parts of more than one county, some little inconvenience may perhaps be felt by a difference of scale, but the advantages of having the line on such maps, are so many and so obvious, as infinitely to overbalance any objection of this kind. Besides, every plate that has a line on it, will become a faithful record of what actually exists, and in the course of a few years will therefore become almost invaluable.—Editor.

Bath and Weymouth Railway.—Subscriptions for this extended Railway are going on it is said rapidly.

London and Brighton Railway.—(Stephenson's line).—The greatest anxiety pervades the sittings of the Committee (of which Lord G. Lennox is the chairman) on this Bill, before whom also the interests of the supporters of the two other projected lines, viz., that proposed by Sir John Rennie, and the other by Mr. Gibbs, are represented by counsel. Mr. Sergeant Mereweather, with whom is Mr Wood, supports the bill, and Mr. D. Pollock appears in support of Sir John Rennie's line, to oppose it; and Mr. Hillier for the supporters of Mr. Gibbs' line. From what we have seen, it would appear to us to be very judicious if the parliament would turn them all out for the present session, as well as the Dover and any others in which great opposition is manifested. Though a session might thus be apparently lost, the probability is that time would in the end be gained, while there would be the certainty of affording more opportunity for the examination of the country, and consequently of securing the best possible line, which, if a railway be a benefit, would be the greatest that could be conferred upon it.

Birmingham and Gloucester Railway.—This bill has passed through the Committee, and is ordered to be reported to the house.

Calcutta and Saugur Railway.—This railway appears to progress rapidly in public opinion, and there is the highest confidence in the vigour, talent, and energy of the directory; public opinion seems to be settled into a conviction of its utility and success.

The tunnel under the line of the Durham and Sunderland Railway near Hetton-le-hole has been completed.

Grand Junction Railway.—Which it is proposed to commence near the Regent's Canal, in the parish of St. Pancras, and extend through Clerkenwell and Hatton Garden to Skinner-street, it is said is likely to be carried.

South-Eastern Dover Line.—Great opposition is manifested to this line from all who have the interest of the country at heart, and generally from all quarters, except from two or three little places near which it passes. These seem to think that the sight of trains flying along to and from Dover will be a great benefit to them, and exalt them into importance; and that the destruction of the great towns, now the heart and arteries of their county, must be to their advantage. It is a pity that such delusions prevail.

London and Greenwich Railway.—In consequence of the conduct of the Greenwich people the line will now turn off at Deptford, and the town of Greenwich will be left to that quietude which, from their opposition to the original intention of carrying the line through that place to Gravesend and Dover, it may naturally be inferred, they coveted. The successful opposition to the Gravesend bill, seems indeed to have been as short sighted as it was unexpected and captious.

A locomotive carriage, having a very simple engine on a new principle, is nearly completed for the Greenwich Railway Company; the frame of which is constructed so that the wheels cannot deviate from the rails at any speed, and that their revolving motion can be instantly changed to a sliding motion; thus the trains, being powerfully retarded by friction, are speedily brought to rest, and the risk of accidents to the spectators and passengers on the viaduct, is materially diminished.

Great curiosity was excited in the city on Saturday, the 5th of March, on the passing along Cornhill of the frame of an engine now constructing for the London and Greenwich Railway Company. This frame is formed on the model of an ancient Roman galley, and when flying along the line will present to the spectator no bad idea of one of those vessels of war, by

means of which, the masters of the world pushed their conquests even to this island.

Gravesend Line.—It is well known that this bill was lost at the second Reading. The true history of it remains a secret; but, surprise is not lessened, since it has been generally admitted, that it was one of the best laid out lines for its length in England. Scandal, of course, deals pretty liberally with this as with all other subjects, on the one hand it has been stated that the directors, men of the highest character, were made the dupes of one of the foulest conspiracies ever planned; and, on the other, that the authorities were persuaded into a belief that the Greenwich pensioners would be disturbed by the trains passing so near the hospital. Poor old fellows, it would be infinitely more likely to amuse them and make them chew their quid the better. However this may be, up to the moment of the second reading, moved by Sir. William Geary—who, it appears, held pretty largely in the rival South-eastern line—the directors were led to believe that no interruption to the second reading would be given, but while the mover was on his legs, it is said that an express came, withholding the consent of the crown.

Be this as it may, the deed is done; but the two companies, the Gravesend and the Dover, have at length united their interest to find and secure the best line to Dover; and there is little doubt but that they have now a line from Deptford to Dover, which for its levels, quantity of traffic, and the general interests of the county, cannot be equalled by any other line.

Great Northern and Eastern Counties Railway.—A sharp contest is expected between these lines.

Grand Connexion Railway.—Some opposition of views appears to be pending between this Company and that of the Birmingham, Dudley, and Wolverhampton Railway; the latter requiring that the Grand Connexion line from Worcester shall unite with their line at Dudley; and in the event of the Grand Connexion Company not acceding to such arrangement, the extension of the Birmingham, Dudley and Wolverhampton line to Worcester, there to unite with the Birmingham and Gloucester Railway is threatened, and the two lines would thus be brought into collision.

The Great Western Railway.—At a numerous meeting of the directors and shareholders it appeared that the district between Bath and Bristol was in such a state of forwardness as to leave no doubt that that portion of the railway would be constructed within the time contracted for. The subscriptions for the intersectional line of railroad to connect the Great Western with Stroud and Gloucester were complete. The only obstacle that the directors had to contend with was in respect to a terminus to the road in the metropolis.

London and Port of Portsmouth Railway.—The railway thus denominated has for its objects the forming of a railroad communication between Portsmouth and London, and by the same line to effect a similar communication between the west and north of England.

Preston and Wyre Railway.—This undertaking is about to be commenced immediately. The drawings and specifications for executing that portion of the line from the Harbour of Wyre to Kirkham will be ready for inspection in the course of the present month; and the whole line of railway from Wyre to Preston is to be completed in twelve months.

Railway from London to Porthynblyn.— It is proposed that the line shall proceed in the most direct route between the two termini; it will emerge

from Montgomeryshire beyond Newton and passing along the valley of the Teme, skirt Ludlow, pass near Worcester, thence to Stratford, Oxford, &c.

Some variations have been proposed in the plan for what we must be permitted to call the "Oxfordshire" railroad. It is now proposed that the line considered as commencing in the Southampton Railway at Basingstoke, passing the Great Western, and proceeding directly north to Oxford and Banbury, should incline beyond Bading a little westward instead of a little eastward, thus passing not far from Warwick, and entering the great London and Birmingham Railway at Stone Bridge, between Coventry and Birmingham. From Stone Bridge the lines of other intended railways proceed to Derby, to Manchester, and to Preston. A survey is also being made for an intended railway from Preston and the important Lancashire districts which shall pass the Shap Fells. This difficult part once accomplished, the remainder of the line beyond Carlisle embraces Glasgow and Paisley, and promises to be the best course for Edinburgh, and almost the whole of Scotland. The whole of the plan, as concerns Oxfordshire, is superior to the former, as far as regards Manchester, but inferior as regards Leeds and the direct north line.

A line of railway is proposed from Rugby to Basingstoke for the purpose of reaching the south of England.

Railway from Gloucester to Birmingham.—The inhabitants of Tewksbury are organizing a most effective course of opposition to the Gloucester and Birmingham Railway; we understand the petition was signed by nearly every respectable inhabitant in the place in a very short time; and when sent off by the mail measured seven yards in length, with double rows of names, and columns for the description of each person signing.

FOREIGN RAILROADS.

Vienna, March 11*th.*—The demand for shares in the proposed iron railroad to Galicia surpasses all expectation. Yesterday the subscription already amounted to 18,000,000 of florins; as the expense is estimated at 12,000,000 only, it was not possible to accept all the offers.

The banker, Baron Von Sina, has presented to the Emperor a plan for an iron railroad to go from Vienna to Gongo, below Raab, to be constructed at his expense, and to go by way of Odenburg; and it is hoped the Emperor will approve of the plan. If this railroad should be carried into effect, Gongo may become the staple place for steam boats, as it has a fine harbour, and the current of the Danube from that place is rapid.

RAILROAD FROM NUREMBERG TO FURTH.

Nuremberg, March 15*th.*—On the general meeting of the shareholders in the iron railroad it appeared, that in the first quarter of a year, just ended, 74,000 persons had made use of it, which produced a receipt of 10,000 florins. It appeared further, that taking the minimum of the receipt during the winter, as the standard for the whole year, the dividend must be 13 or 14 per cent. The shares have, of course, risen still higher, and cannot now be had at 250 florins.

LONDON PRICES, MARCH 30, 1836.

No. of Shares.	RAILWAYS.	Dividend per Annum.	Dividend when payable.	Amount of Shares.	Amount paid.	Prices of Share.
—	Altona and Lubeck	—	—	—	10s.	15s.
—	Birmingham and Derby	—	—	—	5l.	16l.
9,500	Birmingham and Gloucester	—	—	—	5l.	13l.
—	Birmingham, Bristol, & Thames	—	—	—	1l.	2l.
—	Bristol and Exeter	—	—	—	2 10	8l.
660	Bolton and Leigh	—	—	100	—	
—	Calcutta and Saugur	—	—	—	2	4 10
— —	Cheltenham and Great Western	—.	—	—	2 10	7 10
12,000	Commercial Blackwall	—	—	50	2	3 5
60,000	Eastern Counties	—	—	25	1	1 10
—	Edinburgh, Leith, & Newhaven	—	—	—	1	4l.
2,500	Forest of Dean	19s.	—	50	—	
800	Durham Junction	—	—	100	10	
—	Grand Junction	—	—	100	40	
—	Great North of England	—	—	—	2	5 10
25,000	Great Western	—	—	100	10	
—	Great Northern	—	—	—	2	2 5
2,100	Hull and Selby	—	—	50	5	10 5
—	Leeds and Manchester	—	—	—	5	
7,000	Leeds and Selby	—	—	100	—	
2,000	Leicester and Swannington*	—	—	50	50	
5,100	Liverpool and Manchester	10l.	—	100	100	
10,000	London and Brighton (Stevens)	—	—	100	5	20
45,000	——— (Gibbs)	—	—	20	1	1
16,000	——— (Rennie)	—	—	50	2	3 10
12,000	London and Blackwall	—	—	50	3	
—	London and Dover	—	—	50	1	1
30,000	London and Gravesend	—	—	20	1	15s.
20,000	London and Greenwich	3l.	Ap. & Oc.	20	20	31
25,000	London and Birmingham	—	—	100	50	121
20,000	London and Southampton	—	—	50	15	25
7,000	London and Croydon	—	—	20	5	6 10
12,000	London Grand Junction	—	—	50	2	6
—	Manchester South Union	—	—	—	2	5
14,000	Manchester and Chester	—	—	50	2 : 10	
1,000	Manchester and Oldham	—	—	100	3	
—	Midland Counties	—	—	—	5	
—	North Midland	—	—	—	5	14 10
—	Northern and Eastern	—	—	100	3	4
2,500	Preston and Wigan	—	—	—	20	
2,600	Preston and Wyre	—	—	100	3	
1,000	Stockton and Darlington	6l.	—	100	—	
—	South Durham	—	—	—	2 : 10	5 15
—	South Eastern	—	—	—	2	8 10
6,000	York and North Midland	—	—	50	1	

* The editor has received a letter from Mr. Bagster, the manager of this railway, of which the following are extracts:—"The selling price is from 59½ to 60l. A dividend of 25s. per share was paid Sept. 1, 1835; the last half year's balance sheet shows a clear working balance of more than 6½ per cent. per share. The traffic in coal exceeds 3,000 tons weekly, besides lime and granite; and continues increasing."

THE RAILWAY MAGAZINE;

AND

Annals of Science.

No. III. MAY, 1836. New Series.

EFFECT OF THE ATMOSPHERE IN RESISTING A TRAIN.

BY THE EDITOR.

In this age of experiment and research, when men seek to rival birds in the celerity of their motions, and to make tea-kettles their wings, it is rather extraordinary that the effects of one of the greatest opponents to their success should have been almost entirely overlooked. But engineers, whose business it is to deal in clods, bricks, and stone, who plume themselves on the power of an engine capable of whirling along at twenty miles an hour, thirty, fifty, or a hundred tons, seem to think themselves omnipotent, and that a body so light as air is utterly unworthy of their notice, overlooking that the very agent they use is little better than half the weight of the body they despise. Thus it is that we hear some of them occasionally talking of making an engine to travel with its train eighty or one hundred miles an hour. With men of science such absurd assertions only create a smile—with the ignorant a stare of wonder. Let them produce an engine to average fifty miles an hour with a fair load on a railway, and they will richly deserve the thanks of the community. This probably is quite as much as they are ever likely to do; and to promise more, appears to savour of drunken boasting rather than of sober reason. But we will at once proceed with a subject that will in the sequel speak plainer, and with more effect, than any thing we can say; for it will speak the language of generalized facts.

Great uncertainty at present exists as to the actual force of the wind under different velocities, and but few experiments on the subject have come to my knowledge. The difficulty, perhaps, arises from measuring the exact velocity of the wind, or in the reverse case to obtain a rectilinear motion of any length in which the velocity and pressure can be well determined. Dr. Hutton mentions Mr. Smeaton having been furnished with a table of the force of the wind under different velocities, by a Mr. Rouse, probably the father of the present solicitor of that name at Woodbridge, Suffolk, a gentleman who had it seems a great taste for the mixed mathematical sciences. The Doctor compliments the accordance of these results with his own experiments, though at a velocity of 80 miles an hour, Mr. Rouse's table gives a pressure of 31½lbs. to the square foot, and Dr. Hutton's under

26lbs. At lower velocities of course the difference diminishes very rapidly.

Struck with the great amount of the pressure on a moving train, I was induced, since little dependence can be placed on inferential deductions at high velocities, from experiments at low, and since the experiment of Dr. Hutton, from which he forms his table, was made at the velocity of only 13·64 miles an hour, to try if I could not deduce the amount of pressure at once, from the same physical principles, from which I solved in our first number, that most refractory problem, the determining of the true velocity of sound. Let my readers judge, from a comparison with Hutton's table, whether I have been successful.

In the paper alluded to, I shewed that sound was transmitted by the air with the same velocity with which the particles actually moved in the atmosphere; and consequently it follows, that if a body moved in the atmosphere with a velocity equal to that of sound, the air in the rear of it would just be able to follow, but not to press on it. So that at this velocity, the body would just sustain the whole weight of the atmosphere; and the pressure on it would be the same as if it supported the air almost with a vacuum on one side of it. But by the calculation in the paper alluded to, the velocity of sound at the temperature of water freezing, is 1090 feet per second, or 743·18 miles per hour. At this velocity, therefore, and when the barometer is thirty inches, the weight of a cubic inch of mercury being ·49078 lbs., the pressure on every square foot will be $\cdot 49078 \times 30 \times 144 = 2120 \cdot 17$ lbs. If, then, we start from this point, and compute the pressure for inferior velocities in the duplicate ratio of the said velocities, it will give the pressures at such velocities very nearly; for any error which may exist in the non-accordance of the law of the pressures with the squares of the velocities, will diminish very rapidly, and be almost insensible in such low velocities as we need,—that is, velocities under 80 miles an hour, considering the high velocity from which we start.

At 80 miles an hour, our pressure comes out 24·56 lbs.; Dr. Hutton's is 25·75 lbs., and Mr. Rouse's 31·49 lbs. In this very high velocity, therefore, for a moving train, we are only $1\frac{1}{5}$ lbs. beneath the experimental deduction of Hutton; and at the velocity near which he made his experiment, that is fourteen miles an hour, we are 0·75 lbs., and he 0·79 lbs.; that is, differing only 0·04 of a pound.

This close agreement with experiment, I cannot help here observing, is another proof of the accuracy of our physical principles, and on a branch of science to which it was little expected they would apply.

The force of the wind, as it is called, or the resistance of the atmosphere to a moving body, appears to have been given by Hutton and others generally, with little reference to the height of the barometer, and I believe none whatever to the temperature of the atmosphere. This latter quantity seems to be an element never

thought of in a matter of this kind. However, from the method I have followed (though in such rough matters as a moving train it may not), yet in more delicate affairs it forms a very important feature. The pressure calculated for any given height of the barometer and temperature, to be reduced to any other height and temperature, will be as the height of the barometer directly, and the Farenheit temperature plus 448 inversely.

For the purpose of giving every facility to calculation, I have reduced into a tabular form the pressure or resistance in lbs. per square foot to a moving body. It is calculated at the common philosophical standards—that is, an height of thirty inches in the barometer and a temperature of 32° Far. In the next column, I have added the tons, which a space of ten square feet, moving with the velocity in the first column, would increase the load by the mere resistance of the atmosphere alone, and supposing the traction on a level to be, according to Pambour's experiments, eight pounds per ton.

Now it very rarely happens that any train has less than 30 square feet of frontage exposed to the atmosphere. Moving therefore with 30 miles an hour the atmosphere adds no less than 13 tons to the load, that is 43 per cent. on a train of 30 tons, which was about the weight of most of the passenger trains I was on when at Liverpool. If the velocity was 40 miles an hour, the atmosphere would increase the load by no less than 23 tons or 77 per cent., and at about 45½ miles per hour it would double the load. This therefore is a matter of very serious moment in the employment of railway transit, and will be felt in more than one way.

Again, assuming 30 tons as before, to be the load an engine including itself would take along at 30 miles an hour, and that 30 square feet be the exposed surface in a still atmosphere, we shall have for the actual load the engine would draw at 15 miles an hour $(30+13)\times 2-3=83$; to maintain 45 miles an hour, the load the engine could take would be

$$43\times\frac{30}{45}-29=28\tfrac{3}{4}-29=-\tfrac{1}{4}$$

a negative quantity; that is an engine which could carry a load of 30 tons in a still atmosphere, exposing 30 feet surface to the action of the air, could instead of carrying 20 tons, not even move with any load at all 45 miles an hour, so great would be the opposition of the atmosphere.

It was some time since publicly asserted, that Mr. Stephenson had contracted to make an engine to carry a load 60 miles an hour. Let us inquire into the power of such an engine, and the feasibility of the project. In order to make it as favourable as possible let us suppose the engine and its load are only 20 tons, and the exposed surface only 20 square feet, or two-thirds of what I have assumed above. Then the power exerted by the engine at 60 miles an hour must be $20\times 17\tfrac{1}{4}\times 2=54\tfrac{1}{2}$ tons, that is 20 tons for the load, and no

less than $34\frac{1}{2}$ tons for the opposition of the atmosphere. At 12 miles an hour therefore, this engine must be able to draw $54\frac{1}{2} \times 5 - 1\frac{1}{3} =$ about 271 tons, which exceeds by near 40 tons the celebrated exploit of the Sampson engine, and leaves only about 9 tons for the weight of the train and carriages exclusive of the engine, for the load which could be transported at 60 miles an hour. That an engine could be made to take along at 12 miles an hour 271 tons is certainly within the bounds of possibility, but that any reasonable person would talk of attempting a velocity in which $\frac{5}{6}$ of the power of the engine are to be spent in transporting itself and buffeting the atmosphere, is certainly beyond the bounds of probability. Something favourable may likely enough be effected in the figure of the moving bodies so as to reduce the resistance of the atmosphere, and this is a subject requiring prompt and serious attention; but when we consider that carriages cannot be without considerable surface, and that every square foot exposed to the opposition of the atmosphere adds to the load in a train moving at 60 miles an hour, nearly $1\frac{3}{4}$ ton, we shall at once see the improbability of ever making engines to work, economically at least, at such high velocities. They will be like a lady's bracelet—pretty, expensive, and useless.

It is evident from what we have stated, how enormously the atmosphere interferes with our success in accomplishing very rapid transits. In fact there are velocities, and not much above those we have been discussing, in which the whole power of the engine would be exhausted in simple contention with the resisting air, to take itself alone along, without any additional weight. For example, suppose an engine with coupled wheels will take along in about 24 times its own weight from the bite of the wheels alone, and being amply supplied with steam. Now an engine of 10 tons will, I conceive in no instance, as they are now made, present altogether less than 10 square feet front surface to the air. Granting this, our table gives at 70 miles an hour, a load of $23\frac{1}{2}$ tons due to the opposition of the atmosphere alone. If to this we add 10 tons, the weight of the engine, the total load will be $33\frac{1}{2}$ tons. At 10 miles an hour therefore the engine must be able to draw 234 tons, which is about the utmost that an engine would draw were it supplied with steam power indefinitely, for it is about the utmost that the bite of the wheels will bear, according to my experiments in a medium state of the rails. This being the case, conversely an engine of 10 tons which can draw about 234 tons at the most 10 miles an hour, can draw $33\frac{1}{2}$ tons only at the velocity of 70 miles an hour, was there no atmosphere. But in an atmosphere, the resistance with this velocity will be $23\frac{1}{2}$ tons, leaving 10 tons, or the weight of the engine only, for the total load it is capable of drawing.

We need hardly say more to impress on railway companies the necessity in future, of attending to a circumstance of so much importance in the figure and construction of their engines and carriages. Hitherto no regard whatever seems to have been paid to an opponent which we have shewn to be so powerful even when still, but which

should he advance briskly against us, would be altogether unconquerable, or at least would successfully oppose our proceeding with anything like railway speed. All attention appears to have been engrossed in the figure, form, weight, fixing and fitting together of the rails, and the degree of inclination that shall be given to the line in this part or that; but whether it would be advisable to give our carriages one figure or another, to lay out our line in cuttings, so as to compel the air to oppose us in the front, where our face is the least, and its opposition would be the least powerful, have been overlooked in toto. We have proceeded like men who think the atmosphere is of no consequence whatever. One would suppose that we had never been out in a high wind, or experienced its power; or that we are so ignorant of the laws of nature as to believe that a wind blowing against us with 40 miles an hour velocity (a very high wind) is a totally different thing as respects the force of the air to our moving through it at rest with the same velocity of 40 miles an hour.

It was my wish to prove the justness of our observations of the great effect of the air on trains moving at high velocities, by a comparison with some experiments I made on the Liverpool and Manchester Railway, in the year 1834, but have not been able, in consequence of not having the amount of exposed surface. However, this is partially obviated, by an extract made in Mr. Gibbs's Report under our review, from Pambour. The Chevalier de Pambour in making several experiments, has contrived to get an empirical formula for the velocities with respect to the loads, which, he says, represents his experiments very well, and thereupon has calculated what he calls a practicable table, for the loads and velocities of locomotive trains. Unfortunately he has taken a liberty but too common, namely, that of extending his formula beyond the limits of his experiments. However, in the present instance, it is not of very great moment; it being enough for us, that the formula will represent nearly the experiments he witnessed. He has not stated the surface exposed; but as there is a series of computations, I have supplied this omission in part, by determining that which will answer in two of the cases, and then retaining it for all the rest. The quantity of exposed surface I have deduced, is about 48 feet.

Load in Tons.	Velocities in Miles.	Effect of Air.	Exertion of Engine.	Corresponding Velocities.	Difference of Velocities.	Load in Tons.	Velocities in Miles.	Effect of Air.	Exertion of Engine.	Corresponding Velocities.	Difference of Velocities.
	Per hour	Tns.	Tns.		Miles.		Per hour	Tns.	Tns.		Miles.
25	40·1	36·7	61·7	40	0	125	19·0	8·1	133	18½	—½
50	31·3	22·5	72·5	34	+2½	150	16·7	6·0	156	15¾	—1
75	25·7	15·3	90·3	27	+1¼	166	15·6	5·5	171½	14½	—1
100	21·8	11·0	111	22¼	+½						

If M. Pambour's table is worth any thing, these numbers shew pretty incontestably that a quantity increasing in the manner that air increases with the velocity, namely, in the duplicate ratio, does actually increase the load of the engine, otherwise the velocities would be in the simple inverse ratio of the loads, as I have elsewhere shewn. There is, however, another circumstance, which probably has its influence—I allude to the throttling of the steam in its passage from the boiler to the cylinder. In spite of what is said of the dimensions of the steam pipes, being determined from experience to be of sufficient size, I cannot help thinking that they might be enlarged with good effect. This, however, is merely an opinion, not founded on calculation; but I dare say I shall have an opportunity of touching on this subject hereafter, and if I should find my present opinion erroneous, I shall not fail to acknowledge it.

From the powerful influence we have shewn the atmosphere to exert on a moving train, it is evident that every means possible should be had recourse to, for the purpose of diminishing it. The first that presents itself, is obviously that of diminishing the breadth of the front, changing its figure to that of the least resistance, and chaining the successive carriages as close together as possible, so as not to permit the air to take each separately. The next is that of keeping the air always in front, where the exposed surface is the least. With this view, moderately deep cuttings, sloping off as they usually do towards the top, will probably be found very efficacious; but certainly not tunnels. To their other objections, tunnels will add that of rather increasing the resistance of the air, by their contracted limits.

In the following table, I have given the effect of gravity, or the height in feet, a body must fall to acquire the velocity in miles per hour given in the first column, and other columns, to which I shall have to refer in future papers, but which, I thought, while I was about a table, preferable to bring together in one place. It should be observed, that the fifth and sixth columns, giving in one instance the rise or fall of the planes in feet per mile, corresponding to the velocity in the first column, supposing thirty miles an hour be the velocity on a level—and in the other, the exertion, or force of its tension, unity being the force on a level, are both calculated on the supposition of a non-resisting atmosphere.

*** The subject of the present article has appeared so important in reference to its application, that the Editor has thought it needful to postpone the continuance of his last paper, for the purpose of giving it a place.

A FEW WORDS ON RAILWAYS.

By Delta.

In this age of improvements and inventions, nothing perhaps has interested public attention more than *Railways*. These modern wonders are now making rapid strides all over the kingdom, and their rise and progress are truly wonderful; it is difficult in a country like England, in which public opinion bears a decided sway, to discuss any measure that is likely to have a wide influence upon society, with feelings altogether unbiassed, or with a tone perfectly impartial:

"Every white will have its black,
And every sweet its sour;"—

But I will confess that my opinion is favourable to *Railroads*, and I am sorry to see so few scientific men* amongst the names of directors and promoters of these Herculean labours. I think it needs no spirit of prophesy to foresee that all foreign powers, without exception, will follow our example; the time too is not far distant, when these modes of conveyance will become general all over the world. It will of course reduce the price as well as bring new supplies into use. We shall by this means lower the price of all those manufactures, of which the expense of fuel forms a constituent part, increasing the demand for them, and by this method enlarge greatly the circle of British commerce. It is obvious to all that the choicest productions of the earth are of no value, unless they can be conveyed to those for whose use they are designed; and accordingly, we learn that in countries destitute of proper roads, in Spain and Portugal for example and in parts of France, the delightful wines of the various districts are of little value, because they cannot be conveyed to their proper markets. The soil, accordingly, is but indifferently cultivated, each spot yielding but a very scanty produce, for the immediate supply of its own particular neighbourhood. But if railroads were established, its produce could be transported to the sea-ports, or to any of the great markets of the country,—what a revolution would be the natural consequence! Every article of produce would then be at once improved in value by the new demand which would necessarily arise; we should then see the slumbering powers of productive industry awakened, and all the varied and wonderful treasures of nature would be poured forth for the use and comfort of the human race.

National works of such magnitude and expense cannot possibly be undertaken without very serious consideration, and without time to mature and bring to perfection the different designs, to reconcile different jarring interests, and to open the public mind to all their manifold advantages; indeed I hope to see this mighty improvement

* If Delta had seen as much as we have, he would indeed have cause to lament the want of such men among them.—Ed.

adopted zealously throughout the whole of Great Britain and Ireland, but not rashly, and first of all in situations where it is actually called for by pressing inconveniences.

The great object of these mighty undertakings is to remove all the obstructions which occur on roads constructed of the usual materials; and this it does by substituting for the unequal and soft surface of the common roads, a smooth surface of a parallel wrought-iron rail, laid in two narrow tracks, along which the wheels of the carriages roll with a velocity as far exceeding the effect of the most perfect modern macadamized road, as the latter exceeds those known in former times. These tracks are called rails, and are manufactured universally of iron, laid in lengths of from *four* to *sixteen* feet, united firmly together by joints at the end, and resting on blocks of stone, firmly fixed in the ground; these lengths are termed rails. The tracks on each side form what is denominated a single line of Railway. Where there is considerable traffic, another line is put down, parallel with the first, and at about five or six feet distance from the first, which is called a double line, to allow carriages going in an opposite direction to pass each other without interfering. In some instances a third or fourth or more are laid down, if thought necessary; between each there are communications at intervals, by which one overtaking another in the same track may turn aside and pass each other without stopping either. Simple as a railway appears to be, the execution is by no means so easy; and is also attended with great expense. It is only in a country like England that such a scheme can be thought of for the present, abounding as it does with intelligence and science. We do not find until about the middle of the seventeenth century, that I can perceive, any traces of this art of making railways; it appears to have been first introduced amongst our collieries at Newcastle, at which place the immense traffic in conveying coals from the pits to the several places of shipment on the Tyne, rendered its adoption of peculiar value and utility. Since which period, it has been constantly in use,—gradually improving as it made its rapid progress, thereby raising the draught, and adding to the powers of traction. The first railways appear to have been made of wood, and although much superior to the roads then in use, were, in all probability inferior to our present turnpike roads, on which a horse draws about 16 hundred weight at an average; such is the perfection however to which this art has now arrived, that a single horse will with perfect ease draw a load of ten tons besides the weight of the carriage: we may anticipate a still greater increase on the powers of traction. This is the great advantage of the Railways, and adapts them so particularly for the carriage of heavy goods; it will also be a more economical kind of conveyance, as well as being admirably adapted for the purposes of speed, a coincidence which was not once thought of in the original railways, nor by me, to the best of my belief, until the first opening of the *Darlington* and *Stockton* railway in 1825; an invention which at once demonstrated all the advantages of railroads in England. Vehicles have been regularly

plying ever since that period between those two towns on that railway; these vehicles are each drawn by a single horse, they take from 20 to 26 passengers besides luggage; they did not appear to be at all particular with regard to the number they took on each journey; they travelled at the rate of ten miles an hour. It appears a very large load for one horse to take, but the animal appeared not to make the least exertion. These vehicles had no springs, and yet the motion was less than by a common stage coach, and the passengers were frequently seen reading the newspapers on the road. The economy also of this conveyance is another recommendation; the fare being at the rate of only one penny per mile for passengers.

These vehicles roll entirely free from the usual impediments of motion, and such are the great advantages of these railways, over the common roads, it increases the power of draught ten times, even with horses, which is unequalled by any other conveyance.

These wonderful effects are truly surprising, and could not possibly have been anticipated, by the mere changing one material for another. It arises from the probable hardness and smoothness of the metallic surface, thereby exhibiting that grand principle in mechanics, that locomotion is absolutely as natural to bodies as a state of rest, and is quite as easily maintained when once produced, and with so little force, almost as if they were standing still.

Our ancient philosophers imagined that rest was more natural to bodies than motion, but this is a fallacy:—it is easily shewn that an inclination to rest arises solely from the obstacles which come in the way of a moving body. The more we rid ourselves of these, so much the longer does any motion that we impress on bodies continue to actuate them, so that if we could remove all obstructing causes, the vehicles would for ever roll along without any addition to the propelling force. But we can never arrive at such perfection of that kind, on account of the friction or adhesion incident to smooth surfaces, which certainly can be very much reduced, but cannot altogether be done away with. There is one strange circumstance connected with these obstructions, viz. that friction is not increased by the rapid motion of bodies: now this is quite the reverse in navigation; for no sooner does a ship acquire any degree of velocity in the water, than the resistance of the water becomes visible, and thereby a limit is soon attained, beyond which it is quite impossible to advance. This may be seen by watching a train of horses on the banks of any of our canals, striving in vain to advance with any degree of speed.

At sea, even, we are never informed of any ship sailing beyond 10 or 12 miles an hour—even in steam navigation, with their engines of 200 horse power, they scarcely ever exceed 10 or 12 miles an hour. The cause is this, that any fluid medium produces resistance, which increases with the velocity of the moving body, and soon forms a counterpoise to the power that is applied to conquer it.

The resistances that are met with in railways, on the other side, are of such a nature, that they sooner diminish than increase by the

swiftness of motion, so that the faster we move along, affords less time for the retarding force to operate; and by adding to the rapidity we escape in a great degree from its influence, and may advance with a smaller force, should the machinery allow of so quick a rate of action.

This at once shews the nature and advantages of railways, and exhibits at once the magnificent powers of the steam-engine in propelling carriages by land. All the impediments that take place on ordinary roads, to retard the progress of vehicles, are immediately done away with by the metallic smooth level which it affords; and the resistance to the moving body is thereby greatly diminished, so that an engine of small power, is all that is absolutely necessary to drag the most enormous loads with the greatest possible velocity, and greatly surpassing the utmost possible stretch of animal power, because it rolls along unimpeded in any degree by the speed of its motion. It is only on railroads that the locomotive engine has been attended with any thing like success.

The first patent was obtained by Messrs. Vivian and Co. in 1802, and it was first started on the Merthyr-Tydvil railroad, and in the best of my recollection was then stated to have drawn in 1804, ten tons of bar iron, at the rate of five miles an hour; but they did not come generally into use on railroads for the carriage of goods till ten years after. In 1811 there were several engines of this kind in use at the collieries near Leeds, for forwarding coals to the town, but these had toothed wheels, working into a rack of the same description, this invention was liable to many objections.

It appears to have been on the railway at Killingworth, in 1814, that the improvements were made by Mr. Stephenson, the principal engineer of the Manchester and Liverpool Company, by whom most of the engines now in employ were made, so that 40 tons were moved at the rate of four miles an hour, by the introduction of two cylinders, which made the fly wheel unnecessary, as they acted at different parts of the wheels and produced a more regular motion than formerly, but it was still encumbered with tooth wheels.

It was not till 1825 that these tooth wheels appear to have been done away with, and the machinery much simplified, which was found to act proportionably better. In October 1829, the Manchester and Liverpool Company offered a prize, to try the power of these engines; the speed was to be ten miles an hour, and the carriages were to draw six tons. There were two which excited universal attention, viz. Messrs Stephenson and Co's Rocket, with a boiler made by Mr. Booth, of Liverpool; and Messrs Braithwaite and Co's (of London), Novelty. The first of these in this trial of draught, drew 13 tons, about three times its own weight, at the rate of 35 miles in three hours and ten minutes, and the next 35 miles in two hours and fifty-two minutes; the latter drew 6 tons 200 cwt. being three times its weight. The cost of these engines are about 1,000*l.* and they are kept in repair by the builders for 12 months. Messrs. Stephenson and Co's Meteor, with an improved cylinder, of about

20 horse power, the consumption of fuel appears only to have been 528lbs. for 37½ miles, and the cost did not exced *5s. 6d.*; these still continue to be improved from time to time.

The railways ought to receive from Englishmen extensive patronage, as they are English inventions, and therefore this astonishing undertaking claims also an additional support, as it will not interfere with existing interests, and will eventually greatly improve canal property, as well as improve the isolated railways already introduced, (or about to be introduced), by connecting the several branches all over the kingdom into "the grand duct of these several commercial veins in the kingdom," and calculating minutely all the several expenses incident to it, the proprietors will be able to transport heavy goods at the rate of rather less than one farthing per ton for each mile; the addition of dues, &c., I suppose will raise this to three half-pence for coal, lime, straw, &c., and perhaps to *2d.* on grain and some other articles, and *3d.* on general merchandise, while now the charges are from *5d.* to *8d.* including toll-dues. Even on our canals, with the addition of dues, are about *3½d.*; and if we consider the importance of these facts, and their wonderful influence on internal trade, for how great a portion of the several articles of daily consumption consists of heavy goods, it stands to reason that will reduce the price of articles so transported, and therefore will necessarily increase trade in those branches at this moderate rate of carriage. Suppose we take coal for an example; this important article of family expense, the charge of conveying it forms the chief part of the price. Coals you may purchase at the mouth of the pit; this article is sold at the rate of from *5s.* to *10s.* per ton, and at the distance of fourteen miles we find it costs double that sum, so that in fact the natural resources of this country lie waste, and valuable stores of coals, as well as many other mineral treasures in different parts of this country are allowed to rest in the earth, as the sum they would fetch in the market would not be sufficient to defray the expenses. And that is a very excellent and unanswerable argument in favour of railways being established all over the kingdom,—this shews at one view the immediate advantages in pounds, shillings, and pence.

This country has gained the start of all others by this new mode of internal conveyance, by the assistance of the gigantic power of steam; whether we look to *Commerce*, to *Agriculture*, or to *Manufactures*, at a time when the national energy has so much need of a stimulus, owing to the depressed state of the industrious classes. But we must look with a perspective glance, and become prophetic in the case of this splendid invention, and consider it far above all price—it will become a check to the alarming growth of cities and towns, especially in this modern Babylon in which I write; and will, there is no possible doubt, above all, spread knowledge and diffuse intelligence over towns and cities, and finally tend to "universal good."

SUGGESTIONS ON THE PRACTICABILITY OF EMPLOYING THE FORCE OF THE WIND, AS AN AUXILIARRY TO STEAM ENGINES ON RAILROADS.

To the Editor of the Railway Magazine, &c.

SIR,

Reflecting on the great importance of economy in loco-motive power, the idea occurred to me of employing the wind, on long lines of railway, as an auxiliary propelling power, at all favourable opportunities, by means of sails, of such form and dimensions as the nature of the case will admit, and by proper rigging so managed as not to obstruct the sight of the engineer, or interfere with passing trains, tunnels, bridges, &c.

I conceive such a plan might often render unnecessary the use of stationary or assistant engines, in ascending inclined planes, &c. and, among other advantages, will effect a very considerable saving in fuel, &c. and consequently render stoppages for the purpose of taking in supplies of coke and water less frequent.

Should you deem the above idea worthy of notice, perhaps some of your nautical correspondents might be induced to direct their attention to the construction and application of sails in the way proposed.

Apologizing for thus troubling you, I am, Mr. Editor,

Your humble servant,

London, March 17th, 1836. TYRO.

To the Editor of the Railway Magazine.

RESPECTED FRIEND,

Having interested myself a good deal for some years on the subject of railways, I beg to express my satisfaction at thy manner of treating that very momentous part of them denominated *tunnels*. I own my apprehensions as to the effect of long tunnels have gone so far, as to render it very doubtful to my mind if people generally will submit to pass through them unless compelled by necessity, and I greatly fear the end will be, the establishment of rival lines to avoid them, even at the risk of their being some miles longer. Permit me to suggest that a greater service could hardly be performed to the public by the Railway Magazine, than to give them the particulars of the tunnels, and gradients of the several lines of railroads that have been projected; and it is the more necessary from the careful manner in which these particulars are avoided in the different prospectuses.

I may just add that so great are the apprehensions of the London and Southampton directors as to the effect of tunnels, that they have concluded to reduce theirs to about one-third of its first intended length, if not to do away with it altogether.

I am, respectfully,

W. B. WESTLAKE.

Southampton, 4th Month, 5, 1836.

ON THE PHILOSOPHICAL PRINCIPLES OF HEAT, APPLIED TO DOMESTIC PURPOSES.

(Concluded from page 83 of the last Number).

The subject of ventilation, being intimately connected with the successful application of domestic heat, a few words on its importance may not be inappropriate.

The principles of ventilation are, perhaps, better understood than its necessity: numerous evils arise from want of attention to this subject, for the effects being slow, they frequently escape observation, or are considered as unimportant matters.

At a meeting of the British Scientific Association, held at Edinburgh, in 1834; Dr. Joseph Clark read a report containing the registry of deaths in the Dublin Lying-in Hospital, for the seventy-five years preceding: from which it appeared, that prior to 1781, one child out of every six born in the hospital, died within nine days of its birth, of convulsive disease; but the ventilation of the hospital being, in that year, improved, for the five years following the deaths averaged only one in twenty. The effects of bad ventilation here shewn so conspicuously, operate alike on the strong and robust constitution of manhood, as on the more delicate frame of infancy; for, as it requires but one drop of water to disolve a grain of salt, though it takes many for the solution of a rock,—so, the effect is only more visible, but not more certain in the one case than the other.

From the changes which take place in atmospheric air in the process of breathing, it becomes apparent how essential it is to obtain a constant fresh supply of this necessary fluid. At each inspiration about 40 cubic inches of air are taken into the lungs, and about 20 inspirations per minute are made; so that 800 cubic inches of air pass into the lungs *per minute*, and nearly the same quantity is returned by expiration. Air, when it has been breathed, is found to have gained 8½ *per cent.* of carbonic acid gas, and to have lost about 11 or 12 *per cent.* of its oxygen,—or rather more than half the quantity it contained; but as carbonic acid gas contains exactly its own volume of oxygen, it is concluded that 8½ of the 11 per cent. has been expended in forming the carbonic acid gas in the lungs. If the same air be breathed several times, it is impossible to make it contain more than 10 per cent. of carbonic acid gas, and the person making the experiment feels greatly oppressed; which arises principally from the air being unable to carry off the *carbon* from the lungs.

From experiments which have been made by placing animals in glass vessels containing a definite quantity of atmospheric air, it is found that all animals die long before the whole of the oxygen contained in the air be consumed; but, if when the first animal be dead another of the same kind be put in its place, it will live a considerable time in the very same air which was unable to support vitality in the first; and if any substance which has a strong affinity for carbonic acid gas be introduced into the vessel in which the above experiment is made, the enclosed animals will live a much longer time. It, therefore, appears that death was produced more in consequence of the accumulation of carbon in the lungs, than from a deficiency of oxygen.

Applying this to the human body, we find that when pure air is breathed, 68 cubic inches of carbonic acid gas are expired from the lungs *per minute*, which is 8½ per cent. on the total quantity of air breathed; but if the same air be breathed a second time, only 12 cubic inches of carbonic acid can be carried off, being only 1½ per cent., because the air will not contain more than 10 per cent.; therefore 7·10 grains of carbon remain in the lungs, but would have been absorbed in the formation of the other 56 cubic inches of

carbonic acid which ought to have been expired, had the atmosphere been sufficiently pure. If the same air be breathed a third time, none of the carbon whatever will be carried off, and it is therefore evident that, to prevent the accumulation of it in the lungs, a sufficient supply of fresh air must be obtained.

In all ordinary cases, those rooms which have an open fire-place require no further ventilation; but when the number of persons breathing the same air is considerable, then additional means of ventilation become necessary, and the most effectual mode is to have ventilators in the ceiling or highest part of the walls, and this should never be omitted in any room which has not an open fire-place. From the property possessed by all gases, of intimately blending, within certain limits, all noxious vapours are carried off in this manner; for even the carbonic acid gas, though 50 per cent. heavier than common air, when its quantity is not excessive, will be carried off with the lighter gases of the atmosphere, which ascend and escape through the ventilators, in consequence of the hot air of the room being of less specific gravity than the external atmosphere.

In conclusion of the general subject of this essay it may be remarked, that the various methods now in use for the purpose of affording domestic heat, may be all brought under the general principles of one or other of the systems which have been discussed: different inventions may vary in some trifling particulars, but those of each class will agree in their main features, although they may be of various degrees of excellence. Thus, though all hot air stoves are the same in principle, those which burn their own smoke, or at least are said to do so, are the worst; because they oppose the greatest obstacles to the escape of the sulphurated hydrogen, sulphurate of carbon, and other deleterious gases eliminated by the combustion of coal; so also, in warming by the circulation of hot water all those plans must be dangerous in which there is not a free communication with the atmosphere, to allow the escape of steam, and by that means to keep the pipes under 212° of Fahrenheit.

To those whose inclinations or employments confine them much to the house, the subject of artificial heat ought to be particularly interesting, because they are more exposed to the baneful effects arising from an incautious use of the improper methods of warming, which quackery or ignorance endeavour to palm upon the public. We have heard, in the days of Hudibras, of,

> "The man that took the doctor's bill,
> And swallowed it instead o' the pill;"

but in our times people are not satisfied with this, for they swallow both. They certainly swallow the *bill* in the most effectual manner, when they pay a high price for an article which they soon discover to be worse than useless; and they take the *pill* when they allow a dangerous or unhealthy apparatus to remain in their houses, because, having paid for it, they are unwilling to have it removed. It may be said, this is an evil which will work its own cure; and so perhaps it may: but in the mean time, it is but poor consolation to a man who has been thus deceived, to know that others will profit by avoiding his errors.

Yours, &c,

B. F.

London, 20*th February*, 1836.

ON THE PHYSICAL CONSTITUTION OF THE WORLD.*

BY THE EDITOR.

My Dear Sir, *Notting Hill, Nov. 6th,* 1832.

You wish me to give you a short account of the work I am preparing for the press on Natural Philosophy. Instead of doing this in dry detail, I had probably better give you an outline of its objects, not regarding the order followed in the work, which, because of its mathematical connexion is not the best adapted for popular illustration.

It is well known that the physical sciences, before the days of Newton, were little better than a host of negative quibbles and general assertions, having an incoherent plausibility for their base, and fanciful analogy for their demonstration. By subjecting experimental results to mathematical analysis, this great man was enabled to establish a system of physics, containing some of the most beautiful and splendid of nature's laws. This theory of gravitation is well known. But still there is a difficulty attached to it, which, though overlooked in the present day, was a great stumbling-block to its reception at first, and to reflecting minds now, is almost impossible to get over. For instance, it is proved by the best of our observations, that the planetary bodies, though moving with such great rapidity, suffer no sensible resistance; nor do even bodies infinitely lighter, and sometimes travelling with a velocity much greater. So that it would hence appear that the heavenly spaces are absolutely void. But then the question arises, how can one body act on another with such immense power, as is required to prevent the heavy planets from flying off without any connexion or agent between them? Some attempt to avoid the question by saying, that it is a property impressed on matter by nature. Such answers would, like accounting for the ascent of fluids in a vacuo by nature's abhorrence of a vacuum, at once crush all inquiry. Besides, we know from many phenomena, the assertion to be wrong; for there are experiments which shew, that attraction is not constant in the same body but varies with its temperature, and therefore prove that attraction is not an essential property of matter.

Newton saw the full force of this objection, and endeavoured to answer it; in which he has displayed a sagacity very ill appreciated by his followers. Because they have been incapable of profiting by the hints Newton left, these philosophers have discarded them as foibles.

That illustrious man imagined the heavens and all space to be filled with an extremely subtile and active fluid of the aeriform kind, surrounding not only gross bodies, but pervading the pores of the densest and enveloping their minutest particles too. Now if this fluid be rarer in the interior of bodies than at a little distance from them, and rarer at this little distance than at a greater; and so on continually increasing in density as the distance increases; and if the pressure

* There are certain reasons for publishing the following letter now on a most important subject, which was written to a particular friend and read before the Bristol Literary and Philosophical Society about four years ago.—Ed.

increase with the density, small bodies placed in this fluid may on account of the unequal pressures on their farther and nearer sides, be drawn towards other great bodies with all that force, says Newton, which we call gravity.

Thus far Newton advanced. When pressed to explain himself more fully, he candidly acknowledged his ideas to be too crude and confined. In fact he left the matter merely as a hint to be investigated and matured by others. How this medium increased in density, or what law it followed, is wholly unexplained. Physical science was neither indeed at that time sufficiently advanced, nor, as he justly remarks, was he in possession of experiments equal to the undertaking. It was reserved for the philosophers of our own day, to furnish the necessary data, without which progress was impossible.

Now if we regard airs as compounds of particles mutually repelling each other—whether that repulsion be caused by a calorific atmosphere surrounding them, or by a property of repulsion inherent in them—no power of analysis would enable us to advance in the inquiry. Could we now establish any law of heat and connect the laws of repulsion with it, we should gain nothing. For if force be admitted, there is no more objection to an attractive than a repulsive force: and we may as well grant at once attraction between the sun and planets, as repulsion between the particles of the medium.

Discarding, therefore, the idea of forces, the next cause which presents itself is, that all airs be made up of particles perfectly elastic and mutually impinging on one another. The manner in which the particles move in the medium is of no consequence, since their mean motions are all that we have to attend to. This is a very simple and very prolific view; and many of the great phenomena of nature flow from it with singular facility. But when we come attentively to consider the property of absolute hardness, which the ultimate atoms of nature must have, to preserve the uniform existence of things, and other points, with strict mathematical accuracy, we find that the particles of air cannot be elastic.

Confiding in the vulgar theory of the collision of hard bodies, this point very much embarrassed me at first. However, by a close examination I was convinced, that this theory of collision was incorrect; and I therefore endeavoured to investigate the laws of collision founded exclusively on the property of hardness, and, not as it had been usual to do, on the negative assumption of hard bodies not having a property, which it is impossible from their nature they could have. Some time afterwards I was gratified to find, that the theory I had brought out, exactly coincided in the principal points with that given by the celebrated Huygens and Wren, and which for some reason, never properly explained that I could discover, has been superseded by Wallis's, the one now received. By Huygens and Wren's theory, if equal hard balls meet with equal opposite momenta, they will separate the same as if they were elastic; and in all cases, whether the motions be equal or not, they will separate after collision.

A medium might therefore be composed of perfectly hard particles and possess durability, with apparently all the other properties we want.

Admitting this, we may now give a solution to the phenomena of the universe; and by the aid of mathematical analysis, with the strictest rigour and fidelity. I shall here exhibit a popular view of a few of the points, excluding mathematics altogether.

One of the first things which strike us is, that by this theory heat must be motion. Thus, the swifter the particles of an air move about, the more forcibly and the more frequently, in a given time, they strike against the side; in other words, the greater is the air's elasticity. By reducing this view to the operations of analysis, I find, that the elasticity of an air, the space being the same, increases as the square of the velocity of one of its particles, or as the Fahr. temperature plus 448°. So that hence the far famed point of absolute cold, must be 448° below the Fahr. zero, which coincides with what Laplace, Clement, and Desormes have since found. The uniform mixture of gases one with another is also easily explained, and all the other known properties of gases. But there is a consequence of this theory of airs, too valuable to be passed over. It is, that the numbers of particles in equal volumes of any two airs, at the same pressure and temperature, are as the square roots of the specific gravities of the airs. Thus the quantities of combining airs being given, the proportion of particles in the compound is given. By this means I found that two particles of oxygen unite with one of hydrogen to form water; for oxygen being 16 times heavier than hydrogen, contains four times the number of particles in the same volume.

Many other very singular properties are immediately deduced; but there is one of so extraordinary a nature, and at the same time solves a problem of so much celebrity, that I should be inexcusable not to mention it. It is this: having given the specific gravity of an air, its elasticity and temperature, the velocity of its particles may be found, though neither the number of the particles nor the masses be known. The consequence of this is, the determination of the exact velocity of sound; a problem hitherto irresolvable. Analysis gives for it 1089·6 per second at the temperature of freezing water; and the mean result of six of the best sets of experiments, 1089·7 feet.

If a solid or fluid body be made up of particles, the vibrations of them will evidently be more and more powerful, and therefore more and more able to resist the attractive forces by which the body is held together, and consequently of a greater and greater extent as the heat or temperature increases. Hence the expansion by heat is obvious.

It must here be observed, that the temperature is not measured by the velocity, but the momentum of the particles separately; that is, by the mass multiplied by the velocity.

Now if we assume that which all admit, namely, that a change of state in any body (that is from the solid to the fluid, the fluid to the gaseous, or the contrary) is accompanied by a union or separation of the particles, it is clear that a change in the temperature will gene-

rally be the consequence. For if there be an aggregation of particles, the number of particles will be less; and the total motion remaining the same, the individual momentum, and therefore the temperature, will be greater. And the contrary will obviously be the case if there be a division of the particles. Thus in the formation of water from vapour, and ice from water, a rise of temperature ensues, and a depression in the contrary processes. The whole phenomena of "latent heat" is hence easily explained. It is remarkable with what fidelity all the mathematical results of this view accord with phenomena of which something may be seen in the Annals for Dec. 1821.

I do not here design to run into explanations of every phenomena. That of the generation of heat by friction, hammering, compression of gases, &c. is too obvious to require elucidation; but there is one on which a word or two may not be superfluous. I allude to the generation of heat when a body is violently pulled asunder by strong longitudinal tension. Here the particles at the fracture, as the body divides, are by opposite forces drawn considerably farther from their adjacent particles than their ordinary excursions would have allowed them to go. Consequently their returns at, and even before the actual, separation of the body, are more violent, their collisions greater than usual, and of course the temperature is elevated.

How this phenomena is explained on the hypothesis of caloric I have never seen, but I apprehend there would be some difficulty in giving a satisfactory explanation.

The curious property in Iceland spar, observed by Mitscherlich, namely, that the rhomboidal figure approximates more and more to the rectangular cube as the temperature rises, depends on the figure of its integral particles, and being equally well accounted for by either theory, has no claims to our attention.

We may now easily see the cause of Newton's gravific medium increasing in density, as the distance from any solid body increases. As the space increases, the agitations of the body, or of the motion of its particles will evidently be distributed over a greater space, and among a greater number of the medium's atoms, and therefore the motions of the atoms will decrease, and the density increase, as Newton would have it. But the full solution of this problem is one of difficulty, and cost some years in accomplishing. The beautiful views however that it has opened, have been a tolerable reward. I shall just mention one. Philosophers have long known that the planetary bodies decrease in density as they recede from the sun. The earth for instance is more dense than Mars, Mars than Jupiter, Jupiter than Saturn, and so on. In other words they have found that equal bulks of these bodies decrease in attractive energy in a ratio which is nearly that of their distances from the sun inversely. Now to account for this is no easy matter. Some imagine that the Great Architect placed these bodies of different densities in different situations to prevent their being frittered away by the action of the sun. To refer things in this way immediately to the Deity is at once

to gag all philosophical inquiry; and might be equally applied to the finest and the clumsiest system. Doubtless the Almighty works with the utmost simplicity and order; and it is the business of philosophers, if they do anything, to unravel this, the most perfect of all systems. Such has been the view I have taken; but to return: the solution of the great problem of gravitation has shewn me, that bodies do not always attract with the same forces. That the higher the temperature, the stronger this power is; and the difference with the temperature is so considerable, as to amount to upwards of 17 per cent. from the temperature of water freezing, to that of water boiling. Hence the cause of the decrease of attractive energy is the decrease of the temperature; and by mathematical investigation I find the ratio to be that which experience has found to hold.

A reason is also immediately presented, why comets possess such feeble powers of attraction. It is not only on account of the small quantities of matter in them, but the low temperature to which they are exposed by the distant excursions they make into space.

This singular property of a variation in the attraction of the same body, so remarkably verified in the planetary system, I have been anxious to put to a more direct proof by experiments on the earth, and have proceeded a considerable way; but for want of proper conveniences have not completed my object.

One objection will immediately occur to this view of the cause of gravitation. It is found that the heavens are to all sense free from ponderous matter; or if not, that it causes no appreciable resistance to the planets moving in it. This difficulty has been amply answered by Newton in his Optics, and by myself in the Annals for June 1821, p. 410. Indeed the particles may be so small, the velocity with which they move so great, and the medium consequently so active, that though the heavens be densely filled with the medium, no measurable resistance could arise to extremely swift motions. With no other theory of airs could such activity be combined with such vigour. If however the medium possesses any density, one might suppose that though its resistance may be insensible with heavy bodies, yet with very light ones, some effects may be perceived. Now in Encke's comet it is said this has been observed; and if so, it puts beyond a doubt the existence of a gravific medium.

The formula expressing the law of attraction is a fraction, of which the numerator is a given quantity, and the denominator the difference of two squares, one of which is the square of the distance, and the other the square of an extremely minute quantity, which at all sensible distances is of course insignificant, and in minute distances only becomes sensible. So that hence common attraction and cohesion, affinity, &c. are comprehended in one general expression,—an object hitherto in vain desired.

Having disposed of the great principle of attraction, other phenomena immediately arise. One of the first is the decrease of temperature in the atmosphere. We all know the various conjectures that have been made concerning the cause of this, and the endless

attempts to compute the law. Our explanation is exceedingly simple. As the particles of the atmosphere move from the earth, their motions are retarded by their gravitation, and accelerated by the same means as they return. So that the motions being derived from the earth, the higher the particles are in the atmosphere the less must be their momenta, that is their temperature; and the lower they are, the lower their temperature.

The complete mathematical solution of this problem, which rises much higher in the scale of difficulty than that of gravitation, is replete with interesting and useful results, and in my opinion is one of the most satisfactory proofs that could have occurred of the principles adopted. When I inform you that nothing is taken into account in the solution, but the specific gravity of the air; and that from this, without any other experiment either as a check or aid, not only the true rate of the decrease of temperature as one ascends, but the diminution of the barometric pressure; the rate at which sound and heat travel at all possible altitudes, and in all possible directions; all the properties relative to the intensity of sound at various heights, and in any directions, &c. are truly determined, you may form some, but still a very inadequate idea, of the uncommon grasp of this problem.

By the solution it appears, that the temperature decreases nearly uniformly at the rate of 1° Fahr. for every 108·7 yards, or 16°$\frac{1}{5}$ for every mile. In the day the rate of decrease near the surface is more rapid, and less so in the night. The above rate has been compared with 42 observations collected by M. Ramond at various elevations from 300 to 7600 yards, and the mean difference is only about $\frac{1}{5}$ of a degree of centigrade. I have also compared the heights given by the barometric formula of the preceding theory with the observations of Roy, Schuckburg, Ramond, &c., and find the formula agrees better than Laplace's. Indeed Laplace's flows from it, as a sort of approximation. My calculations I see differ but 2 yards from Laplace's in Lussac's ascent of 7630 yards, and 6·7 yards from the same formula in Humboldt's observation on Chimborazo, a height of 6430 yards. These errors are so much within the limits of the errors to which the observations are liable as to be utterly insignificant.

The total altitude of the atmosphere too, at a medium, comes out about 31 miles. But the greater the temperature the higher it is, and the less the lower; the altitude, is indeed, nearly proportional to the Fahr. temperature, at the surface plus 448°.

It also follows, that the quantity of the atmosphere has nothing to do with the height of it; and that the height would be the same, whether there was a tenth, or ten times the present quantity. If the atmosphere be also trifling, compared to the dimensions of the body, its height will be inversely as the specific gravity of the air, directly as the Fahr. temperature, and inversely as the attraction at the body's surface. From this law, several curious phenomena may be derived; for instance, the clear and fine atmosphere, if any on the moon, which, if the same sort of air as ours, ought to be about four times as high;

the extensive atmosphere of Mars; the low ones of Jupiter and Saturn; and the lofty ones of the four small new planets, and of comets in general; together with the long trains which accompany some of the latter. As a curious corollary, I may add that no air of less than about half the specific gravity of hydrogen could be retained as an atmosphere about our earth. May not this be a reason that we have no air of so small a specific gravity? Allow me to put another question by way of rider. May not our atmosphere once have been mixed with an air of less than the specific gravity in question, which, by little and little, was dissipated? And if this air was highly conducive to animal life, may it not furnish a good philosophical reason for the extraordinary ages of the ancients, particularly of the Antediluvians? and the want of it an equally good one for the steady brevity of our lives? This I put merely as a philosophical query, to excite, not to direct the inquiries of the inquisitive.

A remarkable consequence followed the application of the solution of our present problem to the theory of sound. I found that if two bells of equal pitch, &c., were equally and similarly struck, the one being high in the atmosphere, and the other near the surface, that the sound of the lower bell was more intense at the upper station, than that of the upper was at the lower station. In other words, sound ascends better than it descends; a property whose truth, after many fruitless applications to others, a friend pointed out to me in Chladni Traité d'Acoustique, p. 277. But Chladni merely mentions the general facts, and has not determined the ratio, which our theory does, giving it in the mean state of the air, as the three-fourth power of the heights of the barometers inversely.

It was my intention here to go into other parts of natural physics; but I fear I have already said more than will prove interesting, and must therefore for the present, remain,

My dear Sir,

Yours, very faithfully,

J. Herapath.

William P. King, Esq.

[The following lively article is from the Buck's Gazette, and though not perfectly accurate, it is on the whole very faithful.]

RAILROAD TRAVELLING.

Although the whole passage between Liverpool and Manchester is a series of enchantments, surpassing any in the "Arabian Nights," because they are realities, not fictions, yet there are certain epochs in the transit, which are peculiarly exciting. These are the startings, the ascents and descents, the tunnels, the Chat Moss, and the

meetings. At the instant of starting, or rather before, the automaton belches forth an explosion of steam, and seems for a second or two, quiescent. But quickly the explosions are reiterated, with shorter and shorter intervals, till they become too rapid to be counted, though still distinct. These belchings or explosions, more nearly resemble the pantings of a lion or tiger, than any sound that has ever vibrated on my ear. During the ascent they become slower and slower, till the automaton actually labours like an animal out of breath, from the tremendous efforts to gain the highest point of the elevation. The progression is proportionate; and before the said point is gained, the train is not moving faster than a horse could pace, with the slow motion of the animated machine, the breathing becomes more laborious, the growl more distinct, till, at length the animal appears exhausted, and groans like the tiger, when nearly overpowered in contest by the buffalo.

The moment that the height is reached, and the descent commences, the pantings rapidly increase; the engine, with its train, starts off with an augmenting velocity; and in a few seconds it is flying down the declivity like lightning, and with a uniform growl or roar, like a continuous discharge of distant artillery. At this period, the whole train is going at the rate of about 35 or 40 miles an hour!* I was on the outside, and in front of the first carriage, just over the engine. The scene was magnificent, I had almost said terrific. Although it was a dead calm, the wind appeared to be blowing a hurricane, such was the velocity with which we darted through the air. Yet all was steady; and there was something in the precision of the machinery, that inspired a degree of confidence over fear—of safety over danger. A man may travel from the pole to the equator, from the Straits of Malacca to the Isthmus of Darien, and he will see nothing so astonishing as this. The pangs of Etna and Vesuvius excite feelings of horror, as well as of terror; the convulsion of the elements during a thunder storm, carries with it nothing of pride, much less of pleasure, to counteract the awe inspired by the fearful workings of perturbed nature; but the scene which is here presented, and which I cannot here adequately describe, engenders a proud consciousness of superiority in human ingenuity, more intense and convincing than any effort or product of the poet, the painter, the philosopher, or the divine. The projections, or transits of the train through the tunnels† or arches, are very electrifying. The deafening peal of thunder, the sudden immersion in gloom, and the clash of reverberated sounds in confined space, combine to produce a momentary shudder, or idea of destruction—a thrill of annihilation, which is instantly dispelled on emerging into the cheerful light.

* They are not allowed to run down the inclines faster than 24 miles an hour, under a severe penalty.

† This is a mistake: there is but one tunnel, and up that the train is towed very slowly by a rope.—Ed.

The meetings or crossings of the steam trains, flying in opposite directions, are scarcely less agitating to the nerves than the transits through the tunnels. The velocity of their course, the propinquity or identity of the iron orbits along which these meteors move, call forth the involuntary but fearful thought of a possible collision, with all its threatening consequences. The period of suspense, however, though exquisitely painful, is but momentary; and in a few seconds the object of terror is far out of sight behind.

The first-class or train is the most fashionable, but the second and third are the most amusing. I travelled one day from Liverpool to Manchester in the lumber train. Many of the carriages were occupied by the "swinish multitude," and others by a multitude of swine. These last were "neat as imported," from the Emerald Isle, and therefore were naturally vociferous, if not eloquent. It was evident that the other passengers would have been considerably annoyed by the orators of this last group, had there not been stationed in each carriage, an officer somewhat analagous to the Usher of the Black Rod, but whose designation on the railroad I found to be "Comptroller of the Gammon." No sooner did one of the long faced gentlemen raise his note too high, or wag his jaw too long, than the "Comptroller of the Gammon" gave him a whack over the snout with the but end of his shillelagh; a snubber that never failed to stop his oratory for the remainder of the journey.

ON PARLIAMENTARY PROCEEDINGS UPON PRIVATE BILLS.

Every succeeding session of Parliament adds new and increased importance to this subject, and, as yet, the attention of the public in general has never been directed to it. Indeed, with the exception of the solicitors, parliamentary agents, and other individuals, whose business it is "*to get Bills through the House*," few persons are acquainted with the mode in which the proceedings upon private bills are conducted, and none care to inform the public upon a system which works with great advantage to the limited number connected with it. Knowledge is power; and so long as the powert hus conferred is restrained within bounds, the pursuit of such knowledge is confined to the few persons whom accidental circumstances in the routine of life direct in its track. But the public are now sore pressed, by reason of their own ignorance. It is high time that the veil of obscurity, in which the private branch of our legislation has been enveloped, should be torn aside, and that the public should gaze upon a system, of the effects of which they are alone sensible, but the operation of which is less known, though far more visible to them, than the operation of the powers which cause the various forms of material substances with which we are surrounded.

[The remainder of the preceding very able article is in type, and was prepared for press; but the Editor, from other pressing engagements, not having had time for giving it that consideration which so important a subject demands, has for the present withheld it, and will make up the additional quantity of matter in the next number].

RAILWAY NOTICES AND INTELLIGENCE.

The Brighton Lines of Railway.—The rival Brighton railroads are at present carrying on their contest in the Committee, on a question connected with the Greenwich line. The advocates of Mr. Stephenson's line are endeavouring to shew that the number of persons to be expected regularly along the Greenwich line will be so great, that the Company will have no power to convey any other carriages than their own; and that, as Mr. Rennie contemplates coming to London Bridge along the Croydon and Greenwich lines, he will be subject to considerable delay from the crowded and constant traffic along those lines. Mr. Rennie's supporters, on the contrary, affirm, that even should the number of passengers on the Greenwich equal the expectations expressed by Mr. Stephenson's friends, the London and Greenwich Company have taken such prudent measures to provide for an event of this kind, that they are in possession of sufficient land, the whole length of their line, so as to enable them to place two more lines of rails, whenever the increase of traffic may require such additional accommodation. We believe this latter to be the entire fact, but naturally there is much conflicting evidence between the two Brighton candidates.

London and Croydon Railway.—Court of Compensation.—A court was held yesterday, at the Horns, Kennington, before Charles Abbot, Esq., the Under Sheriff for the County of Surrey, and Thomas Platt, Esq., the barrister, as assessor, to award compensation to the proprietors of the Croydon Canal, the greater part of which property is intended to be taken, under the provisions of the Act of Parliament, by the Croydon Railway Company, for the purpose of forming the line of railroad. The Railway Company offered 35,000*l.* as compensation, but this sum was rejected by the Croydon Canal Company. Several witnesses were examined; amongst others, Mr. Rennie, Mr. Tite, and others, who gave it as their opinion that a greater compensation would be necessary to meet the justice of the case. The case was adjourned till this day, when evidence will be brought forward in favour of the Railway Company. Sir William Follett appears for the Canal Proprietors, and the Attorney-General for the Railway Company.

Morning Chronicle, 12th April.

The proceedings in the claim for compensation, made by the Croydon Canal Company against the Croydon Railway Company, were resumed yesterday at the Horns Tavern, Kennington. Several witnesses were examined in behalf of the Railroad Company; when the jury, after a consultation of an hour and a half, delivered a verdict in favour of the claimants, for buildings and land in Surrey and Kent, for 40,250*l.*, and also a nominal verdict of one shilling for profits.

Morning Chronicle, 13th April.

What—only one shilling for the profits of a concern whose property was worth 40,000*l.*!! This must have been a very lucrative concern. It is lamentable it should have been given up.—Ed.

Durham and Sunderland Railway.—The tunnel on this line, under the junction of the Hetton and Elemore railways, near Hetton le Hole, is now

completed. This tunnel is well deserving of the attention of the public,—not from its being such a specimen of substantial masonry, but on account of the almost incredible short space of time in which it was executed. It is nearly fifty yards in length, twenty-two feet in width inside, and sixteen feet from the foundation. The excavation was commenced on the 1st of January, and nearly 4000 cubic yards of earth were worked away; and the walling and arching (in which there were upwards of 1800 tons of stone, and 100,000 bricks used) completed in the short space of a fortnight.

Carlisle Journal.

Instead of having this nuisance in the line, we should be glad to hear that the engineer had done away with the tunnel altogether.—Ed.

Effect of Railways.—At Middlesborough, a few years ago an obscure fishing village, now become a considerable sea-port town on the river Tees, below Stockton, they are now laying the foundation for an exchange. It was stated, among other remarkable facts connected with railways, that the projectors of the Stockton and Darlington Railroad only ventured to anticipate, as the greatest possible export of coals from the Tees, a quantity not exceeding 10,000 tons per annum. This successful undertaking has not been ten years in operation, and yet during the past year between four and 500,000 tons of coal had been exported from that river.

It is remarkable, how much particular circumstances will alter and affect the prospects of commercial matters in a brief space of time. The port of Llanelly, in South Wales, although affording excellent accommodation and anchorage, has hitherto been a place of comparative unimportance; but within the last week, the East India Company have advertised for freight of 4400 tons of coals, to be shipped from the Llanelly Railway Company's wet dock; and the Company having commenced laying down their railway (under the Act obtained last session), through a district abounding with coal, iron, ore, &c., a new outlet will be given to commerce in this quarter. The greatest activity we find is prevailing, and large quantities of produce shipped from this place for home consumption, the Indies, and the colonies.

Courier.

Preston and Wyre Railway and Harbour.—On Thursday last, the first stone of the intended new town on the south side of the Wyre, at Burn Naze, which is to be the manufacturing district, was laid by our member, Mr. Hesketh Fleetwood, in the midst of tenants and persons assembled for the purpose. The flag-staff was duly dressed with the Union-Jack and other flags, and after going through the usual forms of placing under the stone different coins, and christening it by the name of "Wyreton," three times three hearty cheers were given, and prosperity drunk to the new town and the Preston and Wyre Railway and Harbour Company. The worthy member was loudly cheered on leaving the ground; and Mr. Walter, one of the London directors, with the secretary, attended on the occasion. Mr. Decimus Burton, the well-known and highly-talented architect of the town of St. Leonards, has just left Rossall Hall, after arranging and laying-out the plan of the intended new watering-place at the mouth of the Wyre, which is to be called Fleetwood. The survey and sections also of the land for New Liverpool are proceeding, and already active preparations are making for the erection of the new buildings and streets there.

Preston Pilot.

The model of a newly-invented power, applicable for railways, has been within the last few days exhibited at the London Tavern. A very ingenious model is shewn, upon which the principles of the new invention is exhibited. The power proposed to be applied is that of the rocket. The wagons, nstead of being drawn forward, as they are by the ordinary steam apparatus,

are placed before the propelling power. The wagon or engine containing the rocket is placed at some distance behind the wagons or carriages for the conveyance of merchandise or passengers, but connected with them by two bars of iron, which may be made of any length, and thus place the passengers at such a distance from the rocket as to preclude all possibility of danger. By means of the rocket, which has hitherto been only employed in the service of gunnery, a much greater power is derived than from steam, and the projector imagines that the speed of a hundred miles an hour may be obtained from it, without any fuel, or any of the inconveniences occasioned by steam. A rocket upon a small principle is applied to the model engine, which has the effect of propelling five carriages forwards upon the railway, and the speed can be increased to any extent by increasing the power of the rocket. The projector is very sanguine in his opinions relative to the practicability of applying this power to railways. The exhibition appears to give very great satisfaction to the scientific, and other persons who have visited it.—*Morning Advertiser*, 9th April.

We give this as one of the many novelties of the day, but confess our inability to comprehend how we are to be continuously pushed forward by a rocket. We think we could form some idea if it was a barrel of gunpowder.—Ed.

Great International Railways.—London, Paris, Brussels, by Dover and Calais.—The directors of the South Eastern Railway have issued a prospectus under the above title, marked "private and confidential," in which they state that an Act of the British legislature, incorporating the company of proprietors of the South-Eastern Railway between London and Dover, will probably pass in the present session of Parliament; * but the public would do well to suspend their opinion upon the scheme until the legislature determine which is the most eligible line for a railway to proceed from London to Dover, so as to combine the greatest accommodation to individuals, the most expeditious transmission of mails, and the greatest public benefit. It is by no means certain that any of these advantages will be obtained by the line proposed by the prospectus issued.

It has been declared before the committee to whom the bill is referred, that the South-Eastern Railway Company would abandon that part of the bill, which, by a line to Wandsworth Common, would enable them to communicate with the metropolis. This line is therefore only from Croydon to Dover, and it is not defined how travellers or mails by this line are to reach London. The South-Eastern line does not pass through any of the cities or towns in the county of Kent which are of importance in a public or commercial point of view, neither does it pass through those districts where extensive population offers a prospect of advantage to the proprietors.

Besides these things, the engineering objections are said to be numerous and apparent; † and hence it is not to be expected that the committee to whom the bill is referred will sanction a line that is circuitous, and which cannot be effected without many tunnels, and of course a great expense. These observations may prevent hasty speculations; they convey a caution which is the more necessary, as it is rumoured that a line will be exhibited

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* Indeed!—would they afford us a "private and confidential" communication of their authority for this? We tell them publicly and unhesitatingly, that if the line is to depend on its merits, it never will pass. We wish the committee could just go and see their Oxted and Dover tunnels, their gallery, &c. &c., in which a trifling error of about 8,800,000 cubic yards crept in.

† We should say insurmountable.

before the Committee of the House of Commons, in which all that is objectionable, expensive, or difficult, is avoided; a line which, proceeding direct from London, will pass through, or near, Dartford, Gravesend, Chatham, Maidstone, &c. &c., to Deal and Dover,—shortening the time of transit, increasing the facilities of communication both to the government and the public, and shewing, at the same time, a fair source of remuneration to the projectors for their outlay.—*Public Ledger*, 15th April.

London, Salisbury, Exeter, Plymouth, and Falmouth Railway.—On referring to this important undertaking last week, we alluded to its terminating at St. Just, instead of Falmouth. It will now be seen, on referring to the advertisement and engraved plan, that the Company has altered its original line for one that shall traverse the back-bone of Cornwall, taking nearly a straight course from that city to Truro, and branches then to Falmouth and Redruth, whence it may be extended to Penzance. It is, we conceive, the best plan that could be adopted, and the speculation seems to us one fraught with so many benefits to this country, that we have no hesitation in according it our hearty support. We have not space this week to say all that we wish on this Herculean work, but we earnestly recommend it to the dispassionate consideration of our numerous readers, that, if they should view it in the same light that we do, they will give it their substantial support, that Cornwall may partake of those advantages which railroads are so admirably calculated to confer on the country; and we do this without hesitation, for we are informed, on respectable authority, that this undertaking is in the hands of men of powerful talent, great wealth, and unquestionable integrity —determined by uniting their efforts to carry out the beneficial objects they are pledged to attain, by using every legitimate exertion for its success; and as it is the universal feeling that success is not only desirable, but practically attainable, they ask for co-operation and confidence, which will, and must be obtained more and more, as the views of the Company are developed, when they will be believed to be what they are, viz., bona-fide and in earnest.—*Falmouth Packet.*

Mr. Dean and assistants are actively engaged in surveying the line branching from Andover to Reading, which will form an union with the Great Western Railway, thus affording two termini in London, one at the West End, and the other in the heart of the City, at Snow Hill, by means of the Grand Junction Railway.—The Junction with the Great Western will form a direct communication with the Birmingham Great Northern, and all the main railway arteries throughout the kingdom. This will confer great benefit on Portsmouth, Southampton, Salisbury, Andover, &c., by bringing Birmingham, Liverpool, Manchester, &c., within ten hours transit of those towns, while at present it frequently occupies three times as many days. We are happy to say the plan met with the unanimous and hearty approbation of the gentlemen belonging to the Weyhill Agricultural Association, who had the preliminary survey laid before them by a deputation from London, at their meeting, on Friday last, at Andover.—*Salisbury and Winchester Journal.*

Proposed Junction of the London, Salisbury, Exeter, Plymouth, and Falmouth Railway, with the Great Western, instead of Southampton.—The same objections which were given in evidence by Mr. Stephenson, and other engineers, against the Great Western Railway branching from the Southampton line, exist against the Junction of the London, Salisbury, Exeter, Plymouth, and Falmouth with that line, unless the Southampton Directors consent to obtain a new bill, and amend their line; for it would be ridiculous to form a good line from the extremity of the kingdom, 200 miles long, to join a bad working line 56 miles long, terminating at the Western extremity

of London; whereas by joining the Great Western at or near Reading, a complete communication will be formed between Portsmouth, Southampton, Salisbury, &c. with the Birmingham and London Railway, and all passengers and goods from these towns to the Western Counties, would be conveyed to the very centre of the city, at Snow Hill, adjoining the Saracen's Head, by the Grand Junction Railway. At all events, it has been determined on having a branch line surveyed, which is now in operation from Basingstoke, to unite with the Great Western, which will confer mutual advantages that cannot be obtained by a junction with the Southampton Railway. According to the South Western scheme, all the goods and passengers from the counties of Cornwall, Devon, Somerset, Dorset, Wilts, Hampshire, and Berkshire, are to be dragged up the hill from Mitcheldever, where it will unite with the Southampton Railway, to the Popham Tunnel, thence through the Popham Tunnel upwards of a mile in length, and then descend to the same level as Colonel Beach's park near Basingstoke, where the junction of the London, Salisbury, Exeter, Plymouth, and Falmouth Railway was first proposed to be made. An Observer.

The Editor having ascertained the truth of the circumstances stated in the subjoined caution to the Greenwich Shareholders, cheerfully gives it insertion here.

Greenwich Railway.—Caution to the Shareholders.—Whereas various misrepresentations and faslehoods are in circulation, for parliamentary and jobbing purposes, I have taken the trouble to inspect the works, and investigate the same, and I find that the verdict of 40,000*l.* attributed to the Greenwich Company, applied to the Croydon Railway Company, for the purchase of the Surrey Canal; that the crossing of the Ravensbourne Sewer (or river, as it is called) will take place immediately, under the Act of Parliament, and without compensation; that the land on the Greenwich side has been bought for 700*l.*; that the arches now extend to within a few feet of the said sewer on the Deptford side; that the whole of the works from London-bridge will be finished in less than three months, ten foundations for arches only remaining to be excavated; that the funds in hand are ample for the purpose, and that the railway, when finished, will be competent to carry from 50,000 to 100,000 passengers and upwards per day, at 1*s.* each.

April 26. A Shareholder.

FOREIGN RAILROADS.

DR. BOWRING'S NEW JOB.

WE TAKE THE FOLLOWING PARAGRAPH FROM GALIGNANI'S MESSENGER.

"Dr. Bowring, M.P., with Mr. G. Thomas, and Captain Pringle, R.A., have come to Paris as a deputation, for the purpose of obtaining the cooperation of the French government, in a plan for uniting by a general railroad the three capitals of France, England, and Belgium. It is understood, that the governments of all these countries look upon the project with the most kindly eyes, and are desirous of lending it their most cordial support. When accomplished, the journey to London will be performed in thirteen hours and a half from Paris, in eleven hours and a half from Brussels, and from Paris to Brussels in about seven hours."

Now what we have to say upon this subject, may be said in a very few words. If Bowring and Co. wish to persuade the French and English public, that they are the authorized agents of either government, they endeavour to foist a falsehood, a gross and palpable falsehood on the people of both countries. The trio of Scotch worthies are after a private job—a safe speculation, as Dan would phrase it, for the purposes of their own individual interest—as for old Bowring, the fellow never moves without a job in hand, and as sure as ever parliament meets after the recess, we will have inquiry made how this itinerant commissioner is allowed to go about at the public expense, humbugging Frenchmen and Englishmen alternately. It is a most infamous robbery on John Bull, to give this audacious charlatan 2000*l.* per annum.—*Age*, 3d April, 1836.

COMMERCE OF BENGAL.

The important project of obviating the dangerous navigation of the River Hooghly, by the construction of a railroad from Corelior Creek to the Bengalese Capital, and the adoption of Lacam's Channel, and Channel Creek, instead of the old channel, has within the last few days excited increased interest among those connected with India, in consequence of the approaching departure of some of those engaged in the superintendence of the work at the scene of action having engaged their passage in the Repulse, which will sail early for Bengal. In high quarters also, the manifest preservation of life, as well as the advancement of the interests of commerce, has led to an expression of opinion such as might have been expected. The completion of this work would bring Calcutta within *thirty-eight miles* of Channel Creek, instead of being *one hundred and forty-seven miles* from the sea, through the perilous mazes of the Hooghly.—*Morning Herald*, 8th April.

RAILWAY BETWEEN AMSTERDAM AND HAARLEM.

Amsterdam, April 8th.—We learn that the sum required for the construction of our iron railroad between this city and Haarlem is already subscribed, so that we hope that the work may begin without much more delay.

Dutch Paper.

IMPORTANT RAILWAY EXPERIMENT.

Last week an experiment was made in the Champs Elysées, in the presence of a Committee of the Société d'Encouragement pour l'Industrie Nationale, and a number of engineers, on the possibility of running wagons on iron railroads, having curves of a radius less than 50 metres, at an extraordinary velocity, according to the system of M. Laignel. A wagon weighing 500 killogrammes, loaded with 1360 killogrammes of paving stones, started on an inclined plane of one decimetre in every metre, went safely along a curve of 82 metres in length, at the rate of 15 leagues an hour, without going off the wheelway, though the outer band or ridge, was not more than one centimetre in height, and was the only opposition to the centrifugal force. The trial succeeded perfectly, and appears to have resolved a difficulty which has hitherto been considered as insuperable. The system of M. Laignel is extremely simple, and is applicable to all railroads.

French Paper.

When we see this ourselves, we will believe it; but until then, our ingenious Messieurs will pardon us for suspending our assent.—Ed.

RAILROADS IN AUSTRIA.

The iron railroad to Galicia is to be commenced in April. It is hoped that it will be completed as far as Brunn in eighteen months. The journey from Vienna to Brunn with post horses, now takes fifteen hours, then it will require only four hours. The dearness of provisions, which has for some time past been much felt at Vienna, will be remedied in proportion as the

railroad is laid down, because the supplies from Galicia will come more rapidly, and at less expense than they now do. It is true, that it will be full five years before the road can be finished. When we reflect that potatoes cost in Galicia only one third of what they do at Vienna, and that all the productions of the sort are in the same proportion, we can infer what advantages the capital will derive from the railroad.

Allgemeine Zietung, April 1st.

We have seen private letters from Havannah of the 2d ultimo, by the Spey packet, which give an account of the progress making in the construction of the railway from that city to Güines, a distance of fifty miles through a line of country which supplies Havannah with sugar, coffee, &c., for export, and takes off much of her immense importations of merchandise and manufactures. This undertaking is the first of the kind in Cuba, and it is supposed will rival, if not surpass, many in England or the United States in strength and durability. Several miles of the road are now ready for use, and in a few months, fifteen miles will be completed, and opened for the conveyance of produce, merchandise, and passengers. The committee which the Agricultural and Commercial Corporation of Cuba has appointed to superintend the construction of this railroad, seem resolved that it shall be a work of a superior and most substantial character, having ordered the rails, &c., from this country, to be of the most improved description which are in use in England. The locomotive engines and trains for passengers and merchandise, are to be upon the best principle and designs. Upwards of 500 labourers from the United States, chiefly Irishmen, have for some time been employed in the works, and 900 able-bodied labourers have also gone from the Canaries to assist in completing the road with dispatch. The city of Havannah, during the last two years, has been undergoing considerable improvements by the construction of three public markets, widening and paving the streets; and the railroad, which terminates at the entrance to the city, is not the least important. From 1000 to 1500 convicts &c. are daily employed in these public works. The Agricultural and Commercial Corporation, who are constructing this railway, will derive very large returns from the extensive traffic that will be on the road; and the proprietors and planters will be greatly benefited by the facility and moderate terms on which their produce will be conveyed to the Havannah for sale and exportation.—*Morning Herald*, 8th April.

RAILWAY BILLS:

REPORTED.

Bristol and Exeter—Chelmsford—Cheltenham and Great Western—Ulster—Dundee and Arbroath—London Grand Junction—Sheffield and Rotherham—Aylesbury.

COMMITTED.

28th March, Dublin and Drogheda—29th March, Birmingham Bristol and Thames Junction—30th March, Brandling—13th April, London and Norwich Eastern Counties.

PASSED.

Birmingham and Gloucester—Arbroath and Forfar—Great Western—Hull and Selby—Ulster—Dundee and Arbroath—Bristol and Exeter—Sheffield and Rotherham—Cheltenham and Great Western.

N.B. Great Northern Railway Bill lost on Tuesday night by a majority of fourteen.

LONDON PRICES, APRIL 28, 1836.

No. of Shares.	RAILWAYS.	Dividend per Annum.	Dividend when payable.	Amount of Shares.	Amount paid.	Prices of Share.
—	Altona and Lubeck	—	—	—	10s.	1 2 6
—	Birmingham and Derby	—	—	—	5l.	12 10
9,500	Birmingham and Gloucester	—	—	—	5l.	12
—	Birmingham, Bristol, & Thames	—	—	—	1l.	17 8
—	Bristol and Exeter	—	—	—	2 10	6 10
—	Calcutta and Saugur	—	—	—	2	4
—	Cheltenham and Great Western	—	—	—	2 10	5 15
—	Cheltenham, Oxford, and Tring	—	—	—	5	5
—	Clarence	—	—	—	100	45
12,000	Commercial Blackwall	—	—	50	2	2 10
—	Dublin and Kilkenny	—	—	—	2 10	4
60,000	Eastern Counties	—	—	25	1	1 15
—	Edinburgh, Leith, & Newhaven	—	—	—	1	3
2,500	Forest of Dean	19s.	—	50	—	28
—	Glasgow and Falkirk	—	—	—	3	3
—	Grand Junction	—	—	100	40	107
25,000	Great Western	—	—	100	10	35
—	Great Northern	—	—	—	2	1 15
—	Hartlepool	—	—	—	100	80
2,100	Hull and Selby	—	—	50	5	9
—	Leeds and Manchester	—	—	—	—	25 10
10,000	London and Brighton (Stevens)	—	—	100	5	18
45,000	——————(Gibbs)	—	—	20	1	0 15
16,000	——————(Rennie)	—	—	50	2	3 5
—	——————(Cundy's)	—	—	—	2	2 15
12,000	London and Blackwall	—	—	50	3	4 10
—	London and Dover	—	—	50	1	1 0
30,000	London and Gravesend	—	—	20	1	1 0
20,000	London and Greenwich	3l.	Ap. & Oc.	20	20	28 10
25,000	London and Birmingham	—	—	100	50	130
20,000	London and Southampton	—	—	50	15	29
7,000	London and Croydon	—	—	20	5	6 10
12,000	London Grand Junction	—	—	50	2	3 10
—	Manchester South Union	—	—	—	2	5 5
—	Margate and Ramsgate	—	—	—	2	2 15
—	North Midland	—	—	—	5	13
—	Northern and Eastern	—	—	100	3	4 2 6
2,600	Preston and Wyre	—	—	100	3	13
—	South Durham	—	—	—	2 : 10	5
—	South Eastern	—	—	—	2	7
6,000	York and North Midland	—	—	50	1	5 10

THE

RAILWAY MAGAZINE;

AND

Annals of Science.

No. IV. JUNE, 1836. NEW SERIES.

We are happy to perceive by the following article that the subject of making Railroads in Ireland has been taken up by men of respectability, and with that spirit which cannot fail of ensuring success. No one at all acquainted with the history and present state of that country but must see, in the prosecution of legitimate schemes of this kind, a most effectual means of improving Ireland, and one of the best of raising it to equality in point of prosperity with England. We go with our correspondent to the full length of his observations, and are only sorry, with his intimate knowledge of the subject, that he had not extended them. Every man capable of forming an opinion looks forward to the general introduction of railroads in England as to one of the brightest epochs in its prosperity. With how much greater force would this apply to Ireland! We again repeat our regret that Mr. Brodigan, who is evidently so well qualified to do justice to this momentous matter, has not given freer vent to his opinions. So persuaded are we of the necessity of lending every assistance in our power to this important subject, that we have purposely withheld an article prepared by us for the present Number with some care, to make room for the appearance of the following communication.—Ed.

ON THE ESTABLISHMENT OF RAILROADS IN IRELAND.

By T. Brodigan, Esq.

When we contemplate the disposition of the people of Great Britain to improve their means of internal intercourse through the agency of steam locomotive power, the scientific ardour and ability displayed in laying down the various lines of communication, the great national advantages of spending so

much capital at home, and the subsequent impulse to industry created by that expenditure, we find ourselves incapable of estimating the magnitude of the proximate or ultimate benefits that must result from the system. So strongly impressed are the British public that railroads will recreate their capital, so satisfied are they of their individual and national utility, that no less than fifty-seven bills for the incorporation of railroad companies have been presented to Parliament during this session; and with such evidence before us it would rather be a scepticism to question their value and importance, sanctioned as they are by legislative authority, and the noble example set us by the people of Germany and the citizens of the United States. A bare enumeration of the lines projected or forming in Germany and other parts of the Continent would form an enlarged catalogue. The same applies to the United States, where men inheriting the bold spirit of enterprise of their fathers, and speaking their language, are now engaged in an effort that will accelerate the prosperity of that new country by more than half a century. To particularize the railroads made or in course of completion would form a body of matter too large for our space. Suffice it to say, that from the snows of Canada to the tropical climate of the Gulf of Mexico, the traveller or invalid can be transported in the short space of four days. The various states are being intersected, facilities of intercommunication everywhere promoted, and the consolidation of that great confederation of republics is secured by the reciprocity of interests produced by the gigantic arms and iron grasp of the railroad system. But there is one feature in the American projects differing from any that have yet been brought forward in Europe, namely, the Great Coast Line, to run from Bangor in Maine on the Penobscot to New Orleans on the Mississippi, a distance over two thousand miles. No work of ancient or modern times can equal this undertaking. Here is a coast abounding in bays and harbours, accessible at all seasons of the year, the depôts of a thriving commerce; and in the face of the competition of steam navigation a railroad is to be laid down running parallel with the shore, connecting all the maritime towns, and giving to the mutual commercial relations of each all the great benefits of a safe and rapid communication. The course proposed eastward from the city of New York is to lay down a road on the level shore of the south side of Long Island, and from its eastern point to have steam-boats to the nearest harbour on the main land. The course southwards from Philadelphia is to take the eastern shore of Maryland, being a

flat tongue of land with the Atlantic on one side and the Chesapeake on the other. Long Island is about 120 miles long and 10 broad, with the open navigation of the Sound on the north and the Atlantic on the south. Here, then, is the fact of a terrestrial locomotive power setting at defiance the competition of steam navigation, and that in a country where the latter had its origin, proving the disposition of that shrewd and intelligent people to adopt the certainty and dispatch of the one over the risk and uncertainty that must ever attend the ocean and its warring elements.

We have been led into this course of observation from a perusal of the parliamentary notices for railroads in Ireland, where a wide field is open for judicious enterprise. It has been observed by Monsieur Dupont in his work "*Sur les Ponts et Chaussées d'Angleterre,*" that all the public works hitherto constructed in Ireland have been made in advance of its civilization. This, we are sorry to say, is a melancholy truth. The most splendid Custom House in the world has been erected in Dublin, with noble quays, docks, and stores; and there is no adequate trade to employ them. Two canals cross the country to the Shannon; and such is the low value of human labour in Ireland, the competition of horse power broke down the two companies that created them, and they now exist through the aid afforded by the Government. If such results have followed in mere water-carriage, where, it may be asked, is there a field for railroad investment in that country, with the certain knowledge that personal transport only can sustain a railroad? If arterial lines on merely theoretic or geographical views are laid down, as in France, by an unwise dictation of the Government, without trade or population for their basis; if agricultural or pasture districts are to be traversed where there is not a traffic requiring additional facilities; if individuals are not left to their free agency in designing the course of these lines, and to the free spirit of enterprise emanating from a sense of their individual security and interest; if obstacles be thrown in the way of that individual enterprise against the acknowledged commercial maxim of "Let us alone"; if such courses be taken, we say the support or interference of the Government will prove the ruin of such speculations, and throw back the tide of prosperity in that country.

But while we deprecate a pragmatic controul, we admit it is most desirable that certain main trunks should be formed, and that the engineers of the Board of Works should see that the direction chosen by the promoters is such as to admit of

its ultimate extension: if that one point be duly ascertained, it is quite in accordance with the genius of the British Government and the freedom of commercial speculation, that the parties who are satisfied to embark their money in the undertaking should be allowed to do so; and it is equally the duty of the legislature to guard the public in their investments, so as to prevent a waste of capital such as those referred to in canal formation in Ireland.

We have been induced to allude to this intended interference from a knowledge that the subject of laying out arterial lines has occupied the attention of the Irish Government, and that while the subject is open we may throw out our opinions upon it. The state of France at this moment compared to what it might be under a more enlightened policy, is admonitory of the danger of interfering with the designs of commercial companies, having their own gain in immediate view, and in their aggregate exertions advancing the national wealth of their country. But we hope a more enlightened policy will prevail as regards Ireland, where the fostering hand of power should be extended to offer a tardy recompense for ages of commercial impolicy and misrule.

It appears from the parliamentary returns alluded to, that of the fifty-seven Bills before Parliament, only three refer to Ireland. Wherefore this apathy? It is not from any want of capital, where a funded debt of nearly forty millions exists, and where the savings and industry of the people produce an annual augmentation of available wealth. It is not from an ignorance of the advantages of the system, but from a want of confidence in the security for investment, arising from the disasters that have hitherto fallen on great public undertakings. But if a project be put forward by men of business and character, having public utility for its object, with fair security for adequate returns, let, we say, such a work be submitted to the Irish public, and it will meet immediate support. We find this position sustained in the main trunk line of railway from Dublin to the North of Ireland, the first stage of which is now before Parliament. A capital greatly redundant to the wants of the Company has been offered for the first section, and they have turned the tide of popular confidence to the useful object of forming the northern section towards Belfast; thus securing the completion of the first main trunk that will be formed in that country. As illustrative of the value of a free agency in these matters, the whole of the required capital has been subscribed for the first section from the metropolis, and the primary deposits on three fourths of the assumed ca-

pital on the northern portion has been paid. Thus the sum of two millions and a half may be considered as ready for the work, and the sanction of Parliament only is wanting to draw it into action. When it is considered that the province of Ulster is the most commercial in the island, and that its population is the most manufacturing and industrious, a line such as that before Parliament must possess advantages scarcely attainable in any other direction. Passing through the large and enterprising towns of Drogheda, Dundalk, Newry, Banbridge, and Hillsborough, to Belfast, it will perfect the steam intercourse to Scotland; and the first section as far as Drogheda will be the medium of transit for three millions of the northern population. With such resources in the passenger trade, it cannot fail of success under judicious management, and will form, we trust, the first in the series of patriotic efforts to place the sister isle on an equality with the other portions of the United Kingdom.

MR. REYNOLDS'S PLAN FOR RAILWAYS.

To the Editor of the Railway Magazine.

SIR,

THE efficiency of the mode of constructing railways for which I recently obtained a patent having been proved by trials on the Liverpool and Manchester line, I am desirous that it should be submitted to the consideration of parties interested in the subject, more extensively than it has hitherto been. This object would be most appropriately accomplished through the medium of the Railway Magazine, should you consider the following notice deserving a place in its pages.

I will first explain the principle and mode of construction, and then state the advantages which I think the plan is calculated to afford.

The principle consists in affording a continuous and equal support to all parts of the rails by means of cast iron bearers, which rest throughout their length upon and in the ground, and are so connected end to end, as to be equally incapable of flexure at the joints, as at the intermediate parts. The rails are either cast on and with the bearers, forming part of them, or they may be separate bars of wrought or cast iron affixed upon the bearers.

In the annexed drawings, figg. 1, 2, 3, and 4, show a plan and sections of portions of a rail and bearer combined, such as those which have been laid on the Liverpool and Manchester railway. In fig. 1. *a. a.* show where the small end of a bearer rests (with the intervention of solder or other packing) on the large end or saddle of another bearer, to which it is affixed by bolts and nuts, as shown in fig. 4. When several pieces are thus connected the joints are perfectly rigid, and the parts incapable of any motion in respect to each other, except that occasioned by their contraction or expansion, which is permitted by the bolt-holes being larger than the bolts: this, however, will be less than in the usual rails, inasmuch as the bearers being imbedded in the ground will partake of the average temperature of the earth.

In fig. 3. *e. e.* are the spaces left for packing round the ends of the pipes, which should embrace both, and be affixed to each by a separate band. These rails may be cast in lengths of 9 or 12 feet, and will weigh 150 lbs. to the yard. Experience, however, has shown that a considerably less weight would afford sufficient strength and stability. Fig. 7. is a section of cast iron bearers or troughs, in which are placed sills of wood, on which latter malleable iron rails are affixed. The bearers are joined by bolts in the same way as in fig. 1.; they will weigh 100 lbs., and the rails 40 per yard, and the wood will be one third of a cubic foot per yard.

Fig. 8. is a variation of fig. 7. The bearer will weigh 70 lbs., and the rail 28 lbs. per yard.

Fig. 9. is a variation of fig. 2., and will weigh only 84 lbs. per yard. As it is not intended to contain a pipe, the cores need not be extracted, and will therefore be merely pieces of dried loam of any convenient lengths; by this the chief expense of making the castings *hollow* will be avoided.

Fig. 6. is a sketch intended to explain the diminution of excavation and ballasting which arises from avoiding the use of blocks to support the rails.

The *mechanical* advantages of the plan will be most clearly seen by adverting to the evils incident to the usual mode of construction, which are,

1st, That the rails consist of an alternation of *rigid* points of support, and intermediate *flexible* spaces; the consequence of which is, that the carriages passing along them, alternately descend *below* and are projected *above* the mean line of progression, and this occurring five hundred to six hundred times in a minute, is in effect a series of rapid and severe concussions.

2nd, That the supports being independent of each other,

it is impracticable to maintain them at *exactly* the same height. Differences in the stability of the subsoil, and in the degree in which it, and the ballast are consolidated by the workmen, must occur; and slight variations in the rails must preclude *absolute equality* of pressure and concussion on all the blocks. When a block has sunk in ever so small a degree below those next adjoining it, one of these things must happen, either the rail will be held down in permanent flexure, or its efforts to regain its previous position will loosen it from the chair, loosen the chair from the block, or hold the block in suspension.

3rd, That the rails and chairs form a series of levers and fulcra, the action and reaction of which are inconsistent with permanent stability; and the more imperturbable are the blocks, the more severe will be their action on the iron-work they support.

It is evident that the above-described evils have a tendency to produce and aggravate each other. To them the greater portion of the heavy expenditure in repairs of ways and carriages is attributed. Such evils cannot, however, exist in the kind of railway I am describing, because when the bearers or rails are once bolted together, they cannot vary from the relative position so given to them. Hence they can permanently maintain a true plane under all circumstances, except such an extensive giving way of the ground under them, as would be destructive of any other kind of railway. At the same time, the flexibility of the rails will be sufficient to permit their coincidence with such gradual curves as would be produced by the settlement of embankments, &c.

In preparing the ground to receive the rails a general uniformity as to solidity would of course be obtained by rolling or beating it; and all parts of the bearers or rails would obtain equal support from the ground, since stones, Macadam gravel, &c. would be similarly beaten or rolled under and against their sides throughout their length. The stability which the bearers or rails obtain by these means is much greater than is at first sight apparent; for as they press upon the ground equally in a vertical and in a horizontal direction, the mean direction of the pressure will be at right angles to their sides, and consequently the *breadth* of the ground sustaining the pressure increases as its depth below the bearers. Any horizontal force on the rails from carriage-wheels must be accompanied by a still greater *vertical* force, whence the mean of the forces will be more vertical than at right angles to the sides of the bearers, which will therefore, as they form a continuous beam,

afford a much greater resistance to lateral displacement, than can stone blocks.

When we observe that an ordinary turnpike road is not impressed by a coach-wheel, which places the weight of half a ton, on two or three square inches of surface, it is evident that a rail or bearer which comprehends under the portion which sustains a wheel, many hundred square inches of material similar to that of the road, must be more than sufficiently supported. Hence it is believed that rails or bearers of the dimensions shown in figg. 8 and 9, will form a steady and durable railway; this will be immediately put to the test of experiment.

Professor Barlow has shown in his Second Report to the London and Birmingham Railway Company, that the deflection of railway bars adds materially to the resistance of the trains. The extra consumption of tractive power from this cause of course cannot occur on the non-deflecting rails. These rails also possess the advantage of being able to sustain much greater weights than are admissible on rails supported at intervals. Hence larger boilers may be given to the engines, and thereby the requisite supply of steam be obtained, without the destructive intensity of heat which is unavoidable in boilers of limited capacity.

It has been objected to the use of cast iron rails that they will wear much faster than those of wrought iron. This opinion is, I believe, founded on a comparison of the latter with rails and wheels made of foundery iron or *soft* cast *iron*. The *hard* or "bright forge" quality is both the strongest and cheapest description, and less liable to wear than wrought iron. On this point I would refer to an able paper in page 61 in the Second Number of the Railway Magazine *.

I have now to advert to the advantages of the plan in point of economy; but as these are comparative, I can here only mention them generally, though I am prepared to substantiate them in detail in respect to any particular cases. They are,

1st, In excavation and ballasting there would be a saving on the London and Birmingham line, for instance, of about 15,000 cubic yards of the former, and 5,000 yards of the latter per average mile. It may be more or less on other lines, according to the proportion of cutting. This is explained by fig. 6. The excavation on the platform will of course require a corresponding depth on the side slopes.

2nd, In cost of materials and expense of laying, the saving

* Written by a gentleman of considerable science and practical acquaintance with the subject.—Ed.

may vary from 100*l.* to 1000*l.* per mile, according to which of the before-described modes of construction is adopted, and the plan with which it is contrasted. By a method, which I need not here explain, the bearers or rails may be laid with much greater facility and despatch than rails on blocks.

3rd, In maintenance of way. The saving in this respect can only be ascertained by experience; but from the passive stability which results from the mode of constructing and supporting this railway, it is difficult to apprehend any occasion for repairs, except the subsidence of the ground, and in this case the rails may be raised by merely beating gravel, &c. under and against the bearers, without disconnecting them; or this may be effected by proper compressing rollers drawn by horses or engines, the expense of which would be trifling compared with that of digging out the ground around the stone blocks, and forcing ballast horizontally under them whenever they require adjusting. If bearers with *wood* are used, it may be preserved from decay by boiling it in tar or turpentine, or by Mr. Kyan's process.

4th, In the repairs of engines and carriages there will of course be a reduction of expense proportionate to any improvement of the roads on which they travel.

In December last some rails of the construction shown in fig. 1. were laid on the main line of the Liverpool and Manchester Railway, which have continued to the present time to be perfectly firm, straight, and level without requiring any repairs. This experiment was considered to be conclusive as to the stability of the plan on firm ground; but it was questioned by some of the Directors whether the rails would stand on embankments or weak ground; and they suggested that some of them should be laid on Chat Moss*, as affording the severest ordeal to which their suitableness for such circumstances could be subjected. Accordingly a length of 45 yards was laid on one of the weakest parts of the moss about six weeks ago. This experiment has fully answered my expectations; the rails continue perfectly firm and level, and have not needed repairs or adjustment since they were first laid down; their stability as to flexure contrasts strongly with that of the adjoining malleable rails on wooden sleepers. In fact, when the rigidity of the rails and the inflexibility of their joints are considered, it is evident that either they must

* This we think, with the Directors, will be an *experimentum crucis*; and the result will be a language intelligible to all, and which none can contradict. From what we have seen of the models and the subsequent statement, we think our ingenious Correspondent has but little to apprehend.—ED.

prevent the wave or indentation of the surface of the bog caused by the engines and their trains, or that they must be broken into short pieces if the incumbent weights made them yield to such waves or indentations as occur on the other parts of the railway over the moss.

I may mention that this plan will permit the adoption of means for preventing trains from running off the rails, which I believe will be effectual under any circumstances; but which, having already occupied so great a space in your publication, I will reserve for a future communication.

Models of the rails and bearers may be seen at my Solicitors', Messrs. Rowland and Young, White Lion Court, Cornhill.

Assuring you that I shall thankfully receive the correction of any errors I may have fallen into,

I am, Sir, your obedient servant,

JOHN REYNOLDS.

White Lion Court, Cornhill,
London, May 1836.

THE CALCUTTA AND SAUGUR RAILWAY AND HARBOUR.

IT is assumed that the notice before published of this important undertaking has amply proved the safety of the navigation of Lacam's Channel and Channel Creek, as well as of the facility with which the subsequent part of the projected work may be perfected; and this, too, not upon the evidence of interested or ignorant parties, but upon the testimony of honourable and practical individuals, who, in the statements then adduced, could be biassed by no selfish motives, but must have been guided alone by their duty to the East India Company, whom they served, and by the vital importance appertaining to a plan so interesting in every point of view to the commerce of Bengal. It must not be forgotten, also, that however flattering the reports of the officers and gentlemen alluded to may have been, that a partial, and indeed a very partial, advantage was contemplated by the adoption of Lacam's Channel at that period, in as much as the continuance of this route by a railroad from New Harbour to Calcutta formed no part of the project of Mr. Lacam referred to in the former notice.

At once, therefore, admitting that the *safety* of the naviga-

tion to New Harbour has been proved, and the continuance of the route to Calcutta by railway equally so, it is only necessary to state that an additional advantage is more than likely to arise from the completion of the project of the Calcutta and Saugur Railway and Harbour, by the almost entire (if not entire) abolition of that obnoxious and expensive drawback on the trade of Calcutta, *the pilot service*; the injurious and inconvenient effects of which need not be dilated upon, since all who have had occasion to navigate the Hooghly river must have feelingly and powerfully been made acquainted with them. It would seem, indeed, as if a double bar had been placed against the commerce of Calcutta; the first portion in the dangers offered by her waters, and the second in the nuisance by which alone those dangers could be partially avoided. The Bengal pilot service, indeed, appears to have afforded, from the first, but a series of evils, in the shape of expense and extortion, without any adequate set-off in that of advantage. Nor is this opinion formed upon any idle splenetic feeling, or based upon mere theoretical reports; on the contrary, it is founded, as were the facts stated in the former notice of the Calcutta and Saugur Railway and Harbour Company, upon the experience of men of honour, character, and independence. And it is upon such opinions as these that the Company found a just expectation that the maturity of their undertaking must be followed by such an improvement of the pilot system as will produce the happiest effects, if it be not attended by its total extinction. The evidence of Captain Cumberledge, of the H. C. S. Charlton*, shall be first taken; and this Commander, in a letter to Mr. Lacam, says,—

"I have been some days past employed in your service, in writing to a Director a statement of the Charlton's passage up the Channel, and also my opinion in every monsoon, inward and outward bound, of the advantage of the Channel, as also the saving that might accrue to the Company, in the Pilot service."

After some other observations not bearing on this point, he adds,—

"A lighthouse, erected on a point of land as marked on the chart, (i. e. Lighthouse Point,) would be seen, both by day and night, at a distance from danger, and would lead a ship into safety at all times, without the assistance of a pilot."

Mr. Finlayson, master of H. M. S. Fiorenzo †, in a com-

* A ship of 820 tons.

† A 36-gun frigate.

munication to Mr. Lacam, not only corroborates Capt. Cumberledge as to the needlessness of pilots up Lacam's Channel, but, alluding to the latter observation made by him, says,—

"And he might have added, with less risk and in less time than all the Bengal pilots could through any other passage."

Mr. Finlayson, on the same subject, observes,—

"So that your plan supersedes a large and shamefully expensive establishment, in which a number of individuals are interested," &c.

He further adds, addressing Mr. Lacam,—

"From my knowledge of the navigation amongst the sands, I will venture to say that no vessel can run into safety from bad weather, or from an enemy, without a pilot, except through your Channel; and I am confident that every unprejudiced man who has had the experience of three years constantly among the sands that I have, will agree with me in opinion."

He states, in addition, "The first season the Fiorenzo was stationed at the Sandheads, we had a Pilot—it being customary for His Majesty's ships cruising on that station always to have one, but we found him of so little use, that during the last two years we would not be troubled with them. On referring to the log of that ship, you will find, that on the 29th Dec. 1804, with a Bengal Pilot on board, we beat up the Eastern Channel*, till in lat. 29·07 North, when the fellow found himself in the Western Channel; in consequence of which, he crossed Saugur Sand in four fathoms, and got into seven fathoms soft mud, where he anchored the ship at 8 P.M., thinking himself in the Eastern Channel. At daylight I saw the land, and knew, from that circumstance, we were in your Channel."

The above is a fair sample of the ignorance to which life and property have been intrusted under the Pilot system.

Mr. Finlayson continues—"Again, on the 1st of Feb. 1805, with an old Pilot on board, we were run up the Western Channel instead of the Eastern one; till in lat. 21·22 North, when we saw the buoy of the French Flat, and not before, did he find out his mistake; we were, of course, obliged to beat back again, attended with no little risk."

The above needs no comment.

Mr. Finlayson proceeds to state that the same Pilot contrived to run the captured French frigate Psyche on Fisherman's Flat, and she was only saved by throwing overboard her guns and stores; and, after alluding to the errors of the Pilots with regard to the tides, he concludes as follows:—

* A passage up the Hooghly between Thornhill's Channel and Saugur Island.

"Now, sir, on examining the log of that ship (the St. Fiorenzo) for the last two years, when we had no Pilot, you will find we never made a mistake of this kind; and many a time have we collected and given protection to four, six, and eight valuable ships, which have been beating about among the sands for a fortnight, and some longer, with boats gone for several days up every Channel they could find for a Pilot."

"An instance of this kind happened when we collected eleven sail in your Channel. We saw the land, and had your judicious plans been adopted, all these vessels might have gone safely up your Channel, *without a Pilot*, instead of beating about."

Capt. Thomas Lambert, of the Snow Cuddy Burkas, being in Balasore Roads, on the setting-in of the monsoon, and not finding any Pilot Schooners, to save himself, vessel, and crew, ran up the New Channel to New Harbour, by the soundings laid down, *without any Pilot*.

Capt. Savage, of the Honourable Company's ship Duke of Cumberland, in consequence of Mr. Lacam's desire that he should examine his plans, and the Channels leading to New Harbour, did so, and on his first examination states,—

"That this passage has by far the greatest depth of water, and that the width of the river is, in all parts, sufficient for the largest ships in the navy."

Capt. Savage further says, "I commenced a second investigation, and was out of sight of land. Mr. Lacam conducted the vessels into Saugur Road* during the course of a dark night, guided by lead and line only, the least water 4½ fathoms, and we entered the shoalest part at low water; by which it is proved, that there is more water to be had up the small entrance of the Hooghly at low water, than over the Eastern Brace at high water. And it is also to be observed, that from the tail of the Eastern Sea Reef, into Balasore Roads and the Ingerlee, is 130 miles, while this passage makes a run of only 38, and must prove a considerable reduction to the Company's risk, as well as a secure station for large ships in the Royal Navy."

The evidence of Mr. Benjamin Lacam himself is altogether omitted in this notice; because, however satisfactory, convincing, clear, and valuable it is, yet, as an interested individual, and that too most deeply, it has been considered that such might be cavilled at; and there is such ample and overwhelming proof from disinterested parties of the facility of

* The new Channel.

navigating Lacam's Channel and Channel Creek, and of the consequent probability that pilots may with safety be dispensed with, or, at all events, greatly lessened, that such need not be brought forward.

Captain Horsburgh,—whose name alone is a tower of strength,—after some preliminary observations, having for their object to show the advantages of adopting Lacam's Channel, adds,—

"Were a lighthouse, therefore, erected on the point of land that forms the eastern side of the Baratulla Channel, I apprehend there would be no difficulty in going into it *without a pilot* in the day, as the lighthouse would probably be visible from the tail of Saugur Sand (distant about 15 miles from it), and long before a ship approached the tail of Lighthouse Sand."

Capt. Horsburgh continues,—

"Secondly, with a floating light on the tail of Saugur Sand, and a lighthouse upon the eastern point of Baratulla River, I conceive a ship might sail into, and out of, this Channel, even in the night. I have myself seen several ships work up the Baratulla Channel in the N.E. monsoon (considering themselves in the Saugur Channel), until they discovered where they were by seeing the *high tuft of trees* on the projecting point of land, bearing about N. by W. and N.N.W."

To these remarks little need be added, but should the adoption of Lacam's Channel not be attended by an entire extinction of the Hooghly Pilot Service, there can be no doubt of its causing such a reformation in this extensive and inefficient system, as must materially facilitate the purposes of commerce, and greatly reduce the expenditure that vessels are subject to under the present custom. In support of this expectation, as well as of all others entertained by the Calcutta and Saugur Company, most powerful evidence can be brought forward. John Mills, Esq., amongst other valuable and accurate remarks respecting the erection of floating lights, buoys, &c., observes:—

"In addition to the foregoing suggestions and observations, if Government should, at any future period, find these advantages I have endeavoured to point out not problematical but certain, a much greater gain must eventually take place, should it be deemed expedient to build a lighthouse upon False Point, &c. It is with confidence presumed that the following favourable circumstances would follow:—

"First, That no more than *five* Pilot-vessels would be re-

quired to meet the exigencies of the service, if disposed of in the following manner:

"One always to be stationed on the tail of Saugur Sand, within sight of the buoy No. 3; one between the eastern and western reefs during the S.W. monsoon; one to cruise between the western reef and False Point in the S.W., and between Saugur Sand and that point during the N.E. monsoon, ready to give aid to ships in distress, or otherwise, if required. The two others to relieve the former in rotation, for the purposes of being repaired, &c. These vessels to be regulated so as to enable them to take the different stations marked out, in turns, and at stated periods."

Captain Inverarity, in a communication to Captain Horsburgh, respecting the advantages afforded by a lighthouse at this point, says:—

"You will observe, on the adopting the above site, it will not be thought necessary for ships to go into Balasore Roads in search of pilots; my object is to get rid of them altogether, with the exception of a few schooners and a few row-boats."

Some of the above extracts are given merely to show the natural wish of the most eminent of the Commanders of the Bengal trade to rid themselves of the Pilot service, which, by the earlier extracts, there appears every probability of the completion of the Calcutta and Saugur Harbour and Railway fully effecting.

The above is put forth in the spirit of candour;—it is not a private opinion, published for individual gain, but a condensed mass of evidence collected from the most experienced fountains—the testimony of honourable men, who could not dream of the project now in embryo; and if the great good attempted can be matured (and there seems no obstacle to its maturity), Commerce will be enfranchised from an expensive nuisance, and a monopoly acting as an incubus to the trade of Calcutta be broken up, leaving it free to those fair profits the industry of the merchant has claim to, and relieving it from those overwhelming charges by which the spirit of mercantile adventure has been too often blighted and frustrated.

OBSERVATIONS ON THE SOUTH-EASTERN DOVER RAILWAY.

To the Editor of the Railway Magazine.

SIR,

HAVING immediately after the publication of your last Number attentively read the remarks of your correspondent "Detector" upon the subject of the projected South-Eastern Railway, I must confess I was led to imagine, from all I had previously heard trumpeted forth by its supporters with the most astonishing zeal and plausibility, that the letter of your contributor was either the offspring of disappointment in one seeking employ, or the effusion of some hireling scribbler at the expense of some "fine old English Gentleman" upon whose domain the line was likely to encroach, and who, reigning all paramount in his own solitary halls, had not yet drank at that fountain of improvement, whose waters are so fast flowing to the most remote recesses of the universe, but like many with whom I have conversed fancied all branches of national science were encroachments, and that a matter involving the interests of millions must give way to the romantic scenery of a summer-house or a dog-kennel. I am now, however, fully able to corroborate the statements of "Detector," having carefully examined all the most difficult parts of the proposed line. Mark, Mr. Editor! I did not ride in a close carriage along the nearest accessible road, taking a bird's-eye view of such parts as were visible from a well-stuffed cushion, but being prepared with a copy of both section and ground plan, I followed my path carefully on horseback, where practicable, and where not so (not unfrequently the case, Oxtead Hill, to wit,) I walked, or rather climbed up, and slid down the various precipices, and my humble opinion is, that if the Bill passes the project will never be completed. I question much if even the Directors ever have witnessed the difficulties of this almost uninhabited and impracticable country, through which they are advocating a railway; at any rate the shareholders have not, or such excessive gullibility could never have existed. By the by, I would suggest that the Committee of the House of Commons should form a jury to view the "locus in quo," and there at once would end this very wildest of speculations.

Your Correspondent has given so full an explanation of the various elevations in your last Number, that he has left me

but little matter upon which to make any special remarks; but I cannot refrain from offering some few observations upon tunnels. I happen to reside within a mile of a railway tunnel, and am continually passing through; it cannot therefore be said that I advance an opinion without experience; and I can assure your readers, and the public generally who are inclined to invest their money in railways, that those lines of road where the passengers are to be buried for several miles will never be patronized; and in such assertion I am fully confident of being borne out by all who have witnessed the vault-like smell, the sudden and earthy damp, which at all times chills the passengers upon their entry, but more particularly when previously scorched by a summer's sun; the severity of a cutting dry wind, which frequently drawing through in opposition to the course of the train, compels the party to close every door and window; or the density of a November fog, accompanied by the confined effluvia of wheel-grease, oil, and various merchandize, such as cheese, bacon, fish, &c., which a steam-engine cannot improve. Some prospectuses, I perceive, hold out the conveyance of manure as a principal feature: what a delectable treat would it be to the south-easterns to travel through the winding recesses of Riddlesdown Tunnel with a train of sweepings from Thames Street, the refuse of Newgate Market, with various other sweets from the metropolis, and before they had many mouthfuls of fresh air to be again run to earth under Oxtead Hill!

Tunnels no doubt are in some instances unavoidable; and if confined to a distance not exceeding two hundred yards, they admit of no valid objection, as both air and daylight in that case may be enjoyed; but the chill of a two miles' subterraneous passage would deter any person of delicate health from ever venturing therein; as would the resounding echo of the rattling of wheels, the puffing of a high-pressure engine, and clinking of chains in utter darkness, or by the dismal glare of lamps, convey a horror which weak nerves could never endure. It is not that I have lately been employed rather prominently upon the survey of the line as proposed from London to Dover through this city, that I venture to draw a comparison, for I believe it is well known that I have long advocated its practicability in opposition to the opinions of scientific men, in full confidence that my local knowledge would bear me out; and I am happy to say, the sections being complete, the result appears triumphant. Let any man of reason disinterestedly compare the projected line of the South-Eastern and Kent Railways; the former has four miles of

tunnel, the latter none. Again, the former exhibits three planes above thirty feet, and the same number above fifty feet per mile; a rise which but a small sprinkling of science is required to show cannot be easily accomplished without stationary engines, a most expensive and dilatory mode of travelling in itself, to say nothing of now and then a rope breaking when about midway, and the difficulty experienced in foggy weather, when the telegraphs cannot be seen from the station-houses. Besides, let me ask, how will it be possible to draw a train by rope through Riddlesdown Tunnel, which gives a three-quarter mile radius, rising partly 52·7 and partly 34·5 feet per mile? The country too through which the South-Eastern Line passes is such as can never repay the shareholders; it touches not a town between the metropolis and the coast which offers the slightest chance for the transport of goods or passengers, excepting Ashford and Tunbridge, both very unimportant places. On the contrary, the projected Kent Line may be chiefly accomplished upon a comparative flat, as it will in no instance be necessary to employ any plane beyond common locomotive power, and, as I have before observed, without a tunnel, unless in passing under a road or a small portion of the cliff at the Dover terminus. Let its opponents say what they may about Boughton Hill, it is not necessary to cut one single spit of its springy running clay.

There is a way from Faversham to Canterbury where the cutting will be through solid chalk and flint, and at such depth only as the South-Easterns would deem a trifle (such would it be compared to the lengths and depths of their various excavations); nor is the distance between those towns increased more than half a mile. The line from Canterbury to Ramsgate is literally a flat; so is it to Sandwich: from thence to Dover a naturally formed inclined plane offers itself, which with perfectly practicable cutting would bring the Dover terminus half way down the castle hill. It may be said, "Why go to Sandwich? look at the map; see your roundabout course." A plain answer suggests itself; a level country is obtained, which gives an opportunity of a branch to Ramsgate, one of the most improving watering places and ports in the kingdom, a port to which the steamers from Calais and Boulogne are constantly obliged to run when they cannot make Dover, and in which I have seen 400 sail of ships at one time. Sandwich, too, is a place of great trade, and independently of a large export of hops and wool, always employs four vessels to London with corn, leather, &c., which return loaded with manufactures, colonial and other produce,

for the town and surrounding country: neither is Deal, within six flat miles of which the rail would pass, an unimportant point for communication when considered as a Government depôt and the key to the Downs. In fact, the reasons for the selection of that course appear twofold: first, the benefits diffused to two populous towns; and secondly, the difficulties attending a direct line from Canterbury to Dover. Here again I speak from experience, as I was employed under Mr. Walker in the survey of that line in November last, when a railroad was in contemplation from Herne Bay to Dover. Whatever that gentleman's opinion may be I know not; but it appears to me that Lydden Hill is perfectly inaccessible to anything but the hardihood of the south-eastern mountaineers: besides, parks and pleasure-grounds would be invaded, and among others that of the *Honourable Member for Dover*. A fair question might be asked in return, "Why go to Oxtead? look at the map; see your roundabout course, much further out of the direct line than Sandwich." The reply could not be that a level country presents itself, and populous towns are touched upon which promise great trade; for had an engineer been dispatched from the metropolis to discover the most unrailway-like piece of ground within thirty miles, he most probably would have selected that between Croydon and Oxtead; and all the traffic which can possibly be expected from such a country is the transit for the first year of a few semibarbarians who have never yet seen the lions of London. (Query,—Has not the magnetic pole shifted to the southward? Does not the needle feeling the iron chain of individual interest, point to Tunbridge in spite of all obstacles, and with still more determined fixity to St. Leonard's?) Compare for one moment the advantages to be realized from so wild a country, with those of the improving town of Gravesend, the population and trade of Strood, Frinsbury and Rochester, the dock-yard and arsenal of Chatham, the proximity to Maidstone by the level of the Medway, the oyster fisheries of Milton and Faversham, the traffic from the city of Canterbury, Whitstable and its neighbourhood, the coast trade of Ramsgate, Sandwich, and Deal. Why these of themselves are almost sufficient for the support of a railroad, to say nothing of Calais and Boulogne passengers: but let there be war, the South-Eastern Railway would not find trade enough to purchase wheel-oil for its trains, or tallow for its stationary engines.

A few short remarks upon the crude and speculative calculations put forth by the South-Eastern Prospectus, and I

shall intrude no further upon your columns, at least for the present. It appears that the concoctors of that splendid mass of figures have been reckoning without their host: they would fain make the public believe that all the passengers brought to London by the Dover coaches come from that place. Now I can tell them that it frequently happens that all the coaches arrive in Canterbury from Dover almost empty; but they are filled upon leaving for London: so also they continually come in loaded from London, and leave almost every passenger behind when starting for Dover. The same with the fish-wains: for a certain period of the year the largest portion of the fish sent to London by the wains from Canterbury is the property of the Torbay men, who rendezvous at Ramsgate; nor could they, from the structure of their craft, the formation and situation of Dover harbour, take their extensive trade to that place or Folkestone. In fact, all the statements respecting coaches, journeys, and passengers, barges, tonnages, and voyages, are so preposterous, so devoid of strength in their *manufacture*, that they fall to pieces upon the slightest touch; mere castles in the air, equalled only by the farfamed flying island of Peter Wilkins.

I am, Sir,
Your very obedient servant,
D.

April 25th, 1836.

ON THE LICENSE OF COUNSEL IN INSULTING WITNESSES.

Mr. Harrison and the Editor.

In the profession of the law there are, perhaps, as honourable and gentlemanly men as any in England; but among them are some who merit a very different character. Few persons who have attended courts of law and other courts but have had reason to complain of the unbounded insolence of some of the counsel. Not unfrequently is the wanton impudence of these men exercised against females of respectability and station in society. How the courts can permit the fair and defenceless part of the creation, whatever they may do with the other part, to be assailed with offensive remarks, tending neither to elicit truth or further the ends of justice, is surprising. We talk of our politeness, we boast of our laws for

the protection of our property, our persons, aye, and our very ears and eyes from indelicate and offensive language, and yet in the places in which these laws are administered there are occasionally men, presumed to have had the education of gentlemen and claiming to be admitted among them, who, for no earthly benefit whatever, scruple not to violate the laws themselves in the grossest manner, and to outrage common decency by language that would get its author scouted from private society. Nay, they go still further, and because they happen to wear a wig and gown, claim from the courts,—whose duty it is to see the laws obeyed, to enforce good manners, and prevent such outrages,—unlimited protection for their conduct, and punishment for those who dare to call them to account.

Now we feel quite convinced there is no such protection; it would be perfectly monstrous if there was. We have higher authority still; we have the assurance of some counsel that any member of that profession "is answerable out of court for what he says in." If this was better known, and they were, as some have been, a little oftener chastised for their unwarrantable insolence, it would be extremely good both for them and the respectable part of the profession. Is one man to insult another before hundreds, by calling him, or endeavouring to make him appear, a liar or dishonourable character, and not to be accountable for it? It is too eminently absurd to carry with it even the shadow of probability. We know that many of the Bar endeavour to propagate different notions, probably as a shield for themselves; but we are quite satisfied no Court would, and we think we might safely say could, second or protect them*.

Mr. Harrison's attack upon the Editor was made in the Parliamentary Committee, and as it was respecting the conducting of this Journal, and has been much talked of, we think it right to lay it before our readers. The Editor had been under the cross-examination of a junior counsel, which was just closed, when Mr. H., in breathless haste, came in to take it up. As soon as he could speak intelligibly, the Committee found that he was extremely anxious to reopen the cross-

* Since writing the above we have heard that there is a law to protect them from having the sins of their tongues visited on their bodies. If not honourable to all, it is charitable to some of them. The only weapon nature has granted to a scolding woman is her tongue, her petticoats man permits to be her shield. So a pert counsel using the same weapon, is supposed in law, we presume, to be of the same gender, and therefore entitled to the same protection, which is very natural.

examination. It had been closed. Well, but he was desirous to say something about the Railway Magazine. Had the Editor been guilty of any breach of privilege? No; but it was a work that came out *once a* month, and every time it came out, and every *week*, it contained the "MOST INDECENT UNTRUTHS" of his clients and their line, the south-eastern Dover line. As soon as we heard of "indecent untruths" we were anxious to hear what they were, and besought the Committee to allow Mr. Harrison to proceed, asserting that we were quite ready to answer any questions he could put relative to the Railway Magazine. Whether it was that the Committee were aware of Mr. Harrison's being addicted to too much poetical liberty in his assertions, and did not wish to see him further exposed; or whether, seeing the unequalled absurdity of what he had already uttered respecting a *monthly* work publishing untruths *every week*, they felt assured that it was one of his usual "facts," and in pity stopped him, we are unable to say; but it is quite certain they did him a very kind and seasonable service, for which we have no doubt he is now thankful, though probably it is a loss of amusement to our readers.

That we should ever wilfully publish an untruth, those who know us, we will venture to say, or who have even witnessed the character of our Magazine, will immediately disbelieve. Why, if there is anything inaccurate in our pages, do not the parties affected send a correction or refutation of it? Nothing is easier. If we refuse to publish their communication, then some charge may lie against us. But no such thing ever has been sent; and it may therefore fairly be inferred that the parties know they have no grounds for complaint, against, at least, the truth of the statements in our Journal. What then becomes of Mr. Harrison? Has he any other choice than that of having been guilty of pitiful invention or contemptible slander?

Neither so familiar with "indecent untruths" as Mr. Harrison, and by no means wishing to rival him in deserving the application of such terms, we confess the words had a sort of grating novelty in our ears; and the next day we sent him a letter, demanding a substantiation or retractation of the charge. Poor man! we do, on reflection, sincerely repent of the fright this letter must have put him in; but we have the satisfaction to find that it produced no unpleasant effects.

Presence of mind in difficulties is acknowledged on all hands to be a very excellent quality: Mr. Harrison, we are told, is not deficient in it, especially when self is concerned. Doubtless former cases rose forcibly before his eyes; and

to prevent a repetition, we presume, he presented the letter to the Committee, demanding that it may be considered a breach of privilege.

Breach of privilege, indeed!—for what? for telling an impertinent man wearing a wig and gown, who had gratuitously insulted us with a charge of having published "*indecent untruths every week*," in a work that comes out once a month, how we should treat him? that is, for a wanton attack in language, which we confess, ought rather to have excited disgust and contempt than anger? We should have cared very little for such a breach of privilege; but we acknowledge we did not like paying fees of twenty guineas and upwards which the justice of Parliament inflicts on every one brought before them, however innocent he be.

That the Committee were amused at Mr. H.'s distress, and thought a wholesome lesson or two would be of service to him, we may fairly infer from some of them having, we are informed, responded to his complaint with a laugh, and the Chairman having silently returned him the letter. However, he had wit enough to get it buzzed about that an Order was granted to arrest the writer the moment he appeared there, and even to take him wherever he could be found, and bring him up on the following Monday. All this we have since found to be, to use his own language, an "indecent untruth;" though we cannot but admire the cunning that could ward off resentment until it could cool down into contempt.

Mr. H. having tried to bring us before his Court, we have returned his courtesy by bringing him before ours. In any future meeting, therefore, harbouring no angry feelings but acting merely on the defensive, we shall think ourselves quits. But should he again have the temerity to provoke our observations, we think we know a few traits of his public career which will make the *learned* gentleman cut many amusing capers before our readers.—Ed.

BRIGHTON LINES.

PLAN FOR ENSURING THE BEST.

The contest in Committee for these lines has been going on with unabated vigour. We are not advocates for the unnecessary spending of money, but we confess we should be glad to see all lines in which there is great rivalry and op-

position thrown out for the present year. We doubt whether amidst so much conflicting testimony it is possible the Committees can come to a just conclusion. Why not defer it another year, and compel the Companies to bring proper models of the grouud for a few miles each side of the line? If this was done at scales of 3 or 4 inches to the mile, or even 1 inch horizontal, and not more than 50 feet vertical to the inch, with the subsoils properly marked, ocular inspection would enable any one to determine in a very short time which was the best line, and whether the engineer had chosen the most advantageous his course would admit. As to the expense, we are persuaded it would be far less to the Companies than the furious litigations now carried on; and if one man (Mr. Tredgold's brother) talked of modelling all England, executive obstacles cannot be pleaded. Besides, these models would be of great value hereafter. Accuracy might easily be ensured, by selecting at random a few of the hills and testing them, making it an attempt at fraud and forfeiture of claim to parliamentary notice if any hills were found 5 or 10 feet in error.—Ed.

Mr. Robert Stevenson's Evidence, House of Commons, March 16, 1836.

You are a civil engineer?—I am.

You have been so for many years?—Yes, I have. * *

In consequence of this experience of yours upon this subject, I believe an application was made to you in the year 1833 to survey a line of communication for a railroad between Brighton and London?—No, to look at some plans that had been made.

At that time (in 1833) was your attention drawn to the directions in which Brighton could be approached by a railway communication?—Yes, it had been even previous to that. * * *

Were you afterwards employed in 1834 in again considering the approaches by a railroad to Brighton?—Yes, I was.

I believe the plans which had been talked of up to that time were subsequently abandoned, were they not?—Yes, they were.

Did you at that time have communication with other engineers also upon the means of communicating by railroad with Brighton?—Yes, I had a good deal of communication.

Were you again also applied to in the last year to consider the subject?—Yes, I was.

Having been thus repeatedly called upon to examine the lines of communication between London and Brighton, did you at last determine upon one line which you thought the best for the purpose?—Yes, I determined on one line, to recommend its being explored in detail.

For the purpose of its being adopted?—Yes.

Is that the line which is now before Parliament under your name?—Yes, it is.

You say you desired it to be investigated; I presume you mean by the detail, taking the levels and making the preliminary observations which are necessary in such a work?—To determine the precise location of the line.

You then decided upon that line of country, and desired it to be more minutely examined, in order to determine the precise line?—Precisely so.

That was in the course of last year?—Yes.

Who was the gentleman that you desired to take the levels?—I recommended Mr. Bidder to the Committee. * * *

Proceeding from the depôt near Vauxhall Bridge, in point of fact, does not the line from thence to the point where you join it go through nothing but open fields, with scarcely any interference with building property?—It is remarkably clear of interference.

Perhaps, till you heard of that line, you hardly thought it possible that such an approach could be had so near to London with so little interference with building property?—Yes, I was acquainted with the district.

It is particularly clear, is it?—Yes, it is.

Is the Southampton line now in progress of execution?—Yes; I have seen some part of it, near Wandsworth, in progress.

I am confining myself to that part of the line which you use?—Yes.

Are the difficult works, those works that require the most time between Nine Elms and that point which you call the junction with the Southampton Railroad, now in a great degree executed?—Yes, they are now in a forward state.

The works there consist of two principal works, the passing over one road by a bridge, and under another road by a cutting?—Yes; I recollect the road only very generally; I do not know the details of it; I know that the works generally are in a forward state.

I will ask you one general question; in your judgment can the rest of the line, as far as you want to use it to Wimbledon, be completed in the course of nine or ten months?—It may be completed in that time, certainly.

Along your own line of road, I believe from Wimbledon, there is no large work till you get to Epsom?—No.

And that is a tunnel, I believe, on Epsom Common?—Yes. * *

Mr. Serjeant Merewether.—Will you have the goodness to tell me what is the length of the tunnel upon Epsom Common?—Somewhere about 800 yards.

Can you tell the width of it?—It is the same as those in the London and Birmingham; the width is 22 feet 6, and the height 25 feet.

You have stated that the length of the tunnel is 800 yards; will you recollect yourself, whether it is more, in point of fact, than 600 yards?—I believe it is 600 yards only.

And the width and the height which you have given are the same

that you have now in execution, under the sanction of Parliament, in the Birmingham Line?—Yes.

Have you every reason to think that they will answer every purpose of the railroad?—I think so.

Do you know what sort of soil the cutting of this tunnel will be in?—The borings have been made on the line; and that is a detail that Mr. Bidder will give.

Have you any reason to apprehend that there will be any difficulty at all in executing that tunnel there, having regard to the strata?—None at all. * * * *

From the tunnel upon Epsom Common you descend into the valley of Mickleham, in the neighbourhood of Leatherhead?—Yes.

Is there a cutting there?—There is a cutting on entering the valley.

In your judgment can the cutting be executed with safety, and at such an expense as is included in the estimate of the work?—Yes.

When you have got down into the Mickleham Valley, have you an opportunity of availing yourself of that valley for a considerable distance?—Yes.

Will the earth that comes out of that cutting, in descending the valley, form the embankment which will be necessary in the course of the valley?—Yes.

What will be the average lead at which you will carry your cuttings upon your line of railroad?—The average lead from the section will, in my judgment, not exceed a mile and a half.

Having got into the Mickleham Valley, you have to pass through Norbury Park?—Yes.

Is it necessary for you, in order to preserve the entrance of that park, to have an archway?—Yes, a very small tunnel, about 100 yards long.

Will there be any difficulty in constructing that tunnel?—I think not.

What will be the width of it and the height?—The same as the other.

Will there be the slightest difficulty in that tunnel of 100 yards with the locomotive engines?—I do not consider any in a tunnel so short as that.

In getting afterwards from the Mickleham Valley at a higher level, have you another tunnel there?—Yes, near Dorking.

I know you do not go into the detail of it, but what is the length of that tunnel?—I think it is about the same length as the other.

The one upon Epsom Common?—Yes.

Have you got a plan at all by you?—Yes. [*The Witness referred to a Plan.*]

I believe you will find that that tunnel is a little more than 600 yards?—I do not recollect the precise lengths.

Will the width and the height of that tunnel be the same as of the other?—Just the same.

Have you any reason to apprehend any difficulty in the strata there in executing that tunnel?—No, I think not.

You have mentioned now three tunnels; will those tunnels have any considerable inclination on them, or will they be nearly level?—They have some inclination in them.

Is the inclination at all injurious for the purpose of their being easily and safely used?—No, I think not.

Do you recollect where it is that you deposit the earth which comes out of that tunnel?—It comes into an embankment just by.

Is this tunnel on the Norbury Park side of the river, or beyond?—Underneath Norbury Park.

The other is further on, when they ascend from the Valley of Mickleham?—Yes.

With respect to these tunnels, you have had considerable experience in tunnels, have you not?—Yes, I have.

Considering the shortness of those tunnels, do you apprehend any material inconvenience in the use of the railroad from those tunnels?—No, in consequence of their shortness I do not.

Then I conclude from that that tunnels of considerable length would be objectionable?—I consider them so, but in some cases they are totally unavoidable.

Then if they are not of an improper length, any inconvenience from them is reduced most essentially?—Yes.

Will you state what, in your judgment, is an improper length?—I conceive that they are very objectionable when they exceed half a mile; but we have some upwards of a mile on the London and Birmingham Line.

You consider that beyond half a mile they become objectionable?—Yes.

Of course that objection increases afterwards in proportion to the increased length?—Yes.

On the Birmingham Line you have some of a mile you say; is that in parts of the country where you could not avoid them?—They were quite unavoidable.

You would have avoided them if you could?—Yes.

Have you any method of ventilating those tunnels?—Yes, we have very large shafts made in different parts.

Will you tell me whether those three tunnels of which you have spoken will require any such means of ventilation, or, from their shortness, whether the aperture at each end will afford a sufficient natural ventilation?—I think sufficient.

From the point that I have spoken of the second tunnel, which is about 15 miles on your line of railroad, you get to your highest summit at Capel?—Yes.

I believe that is about 21 miles and a half along your road?—Yes, about that.

[*To be continued.*]

LONDON AND DOVER ENGINEERING EVIDENCE.

EXTRACTS from the Evidence of GEORGE WALTER, Esq., given before the COMMONS' COMMITTEE on the London and Dover (South-Eastern) Railway Bill, relative to the Greenwich Railway.

The following important Evidence of Mr. Walter sets the stability and capabilities of this line in a clearer light than they have yet been seen.—ED.

Mr. GEORGE WALTER called in, and examined by Mr. GORDON, as follows.

I believe you are the Resident Director of the Greenwich Railway?—I am.

Was that work originally projected with a view to its continuation to Kent and Sussex?—It was.

You made your arrangements for that purpose accordingly?—We did.

What is the width of your property along which the railway goes? —It is 75 feet.

Is that along the whole length of the railway?—The whole length.

How much is occupied by the present line?—25 feet.

Can you, if necessary, without going again to Parliament, widen your railway so as to admit of two distinct sets of railways?—Yes.

On your own property?—Yes.

Supposing the amount of traffic on your railway requires it, are you prepared to make that addition?—We are prepared.

Will you be able to do so without any increase of your present tolls?—We should be able—[*a model exhibited*]—this is the Greenwich line, and this is the Croydon; at this part there will be a house for a man, with a station to watch the arrival and departure and passing of the trains.

By Mr. Rotch.—What is that road below; is it a carriage-road? —It is now a footpath.

By the Committee.—Does that represent your property?—This does, with exceptions.

By Mr. Rotch.—But what represents your property at the foot of it?—The boundary wall, the 25 feet; the space occupied is 25 feet, then on the north of 25 feet and the south of 25 feet is inclosed by the walls.

Have you 50 feet independent of your viaduct?—Yes.

What is the width of that viaduct?—25 feet.

That is, 75 feet between the external walls?—Yes.

By the Committee.—Is that the case through the whole length of your viaduct?—The whole length.

It is not intersected by any other property or building?—None.

When you state the whole length of the line, have you 20 feet from the side of your railway up to where you come on the London Bridge, and in reference to the property of St. Thomas's Hospital?—We have no approach from Duke-street.

All I want to know is, is this your railway, and this your 25 feet? Do you carry the 25 feet right out into the main street at London Bridge, or are you checked anywhere by any building at St. Thomas's Hospital?—Not by any.

You have clear 25 feet, besides the railway, into the main street that goes on the bridge?—That is an approach of 50 feet to the railway.

What is your ground there? show the terminus, the exact terminus.—[*Referring to the plan.*] This is the street leading to the railway at this point.

What width is that?—Fifty feet.

What I want to know is, whether you have 75 feet right home to the Borough end?—At the commencement of the railway it is 65 feet.

That is the whole of the property?—On four lines of rails; it is what we call our station; at the London end we have a street leading to the commencement of the railway of 50 feet.

First you begin with 50 feet for a certain length?—Yes.

What length, for how many yards?—Perhaps 50 yards.

Have you any authority under your Act to continue your railway on that point, which is only 50 feet?—We have; for we have ground on each side. We have bought it on each side.

Can you enlarge 50 feet, and to what distance, under any powers you have?—To the whole extent; that is 150 feet more.

You can enlarge it up to that point?—Yes, up to the corner, to the angle.

What is your next?—Sixty-five feet.

Can you enlarge there?—We can enlarge it; it is 280 feet in length.

Can you enlarge there?—We can enlarge there at that point.

Sixty-five feet is ample width for your four lines of railway?—It is, for six lines. It is ample.

Can you enlarge that 65 feet?—At this point we can very considerably.

But not there without an Act?—Or by consent; we do not require it.

Have you the power of doing it?—We only bought this property marked yellow.

You cannot make it wider through the whole length of that 300 yards; what width do you require for a double set, not two lines but four?—About 20 feet. No, 40 feet for four lines.

You say you have got 65 feet; you said that is sufficient, but have you got any superfluous ground? What is the width you want for four lines?—We have sufficient ground at present to lay down two more new lines of rails. We have enough.

Here is your railroad, which is 50 feet, and 25 feet on each side? —We have bought all that is marked yellow; we have 75 feet every way.

Have you 75 feet on the pink where it passes that road; how can

you extend it to the right or to the left?—Not exactly over the road, but on the other side; we have the ground on each side of the road.

Suppose it necessary to extend the width of the viaduct, have you the power of extending it where there is that road?—Over the road also we have the power.

What is your width there?—Thirty feet.

Could you widen there without another Act of Parliament?—It belongs to the Company, the warehouse.

Why is it not marked yellow?—I do not know why it is not; it is a very large hop warehouse. It cost the Company 14,000*l.*; we can do what we like with it.

Are they all marked yellow?—Yellow and brown.

There is another wide space; is that a road?—It is a road. That is the Company's property that is crossed by a viaduct.

What is that?—A small lane or alley leading into property.

You have a power of increasing the width of your viaduct?—We have it.

Where you cross the road beyond that?—We have the same power the whole way to Deptford.

Have you land still on the Bermondsey road?—Yes, there is a great deal of property.

And on the other side of the Bermondsey road?—Yes, the same width of property, and considerably more on each side of the road.

[The Witness goes to the Counsel and explains.]

Cross-examined by Mr. ROTCH.

You have stated generally that you do not contemplate to increase your tolls?—We do not intend to increase our tolls.

I do not know if you understood that question that was asked as to your increasing and extending the railway to accommodate the two lines of the companies; if you can make those alterations that may be necessary for the purpose of accommodating those new trains, do you still mean to say you will not increase your tolls?—I can only give my own impression that we are bound to give that accommodation to the other companies passing over us; I speak as an individual. I cannot say what the directors will do.

Is there a provision in the Act of Parliament that compels you to let other companies on your line?—Only by agreement with them; we have the power of making our own arrangement.

Though you are compelled to take the traffic along your line that may be brought, you do not mean to say that you are compelled to let another company let their line run into it?—We should do it, because it would be advantageous to us.

That is, if it would?—If it would, we have the power.

Have you made any calculation whatever, or to your knowledge have the company or directors, as to what the expense is that would be necessary for the purpose of receiving the traffic of all those companies?—The estimate of the expense is 100,000*l.* to double the line as far as the junction; to double the width of the present line.

Who made that estimate?—I consulted Colonel Landman on that subject; he said I should be safe in saying that.

You have only that guide to name that sum?—I have the guide from my own knowledge of the expense of the Greenwich viaduct, and of the constructions of the arches.

Then you go on your own judgment as well?—I go on my own judgment as well.

What is the experience from which you take your datum that 100,000 *l.* would be enough; how do you argue that?—In this way; there are about 1,000 arches between London Bridge and Greenwich, it being about half way, of course the expense would be half of the same altitude to the building of the arches. We allow 100,000*l.* for the purchasing of the ground, and 100,000*l.* for the construction of the arches, making the whole amount of 200,000*l.*

You consider that it would be just half that sum; was that sum found sufficient?—Yes, for the building purposes; the building estimate was correct.

Was any calculation made in that as to the tumbling down of arches and building them up again?—No, it amounted to 50*l.*

That fell on the contractors?—It was in consequence of the Irish labourers, who were ordered to place bricks near the arches, removing the shores in frosty weather.

It was not in consequence of any badness of the work?—The work was very good.

In your judgment, 100,000*l.* would be sufficient to make this additional railway?—That is my opinion.

You now speak of the additional road?—Yes, the additional two lines.

What provision have you made for the reception of goods to a large extent, timber, coals, chalk, sheep, cattle, and all kinds of goods of that sort; have you made any?—Yes, our general depôt.

But that is made with reference to what you intend now to do; what would you do if you doubled your line, and had all the South-Eastern Line, and the immense traffic we have heard of pouring in on you day by day, and from the Brighton?—We must increase our depôt at the London end.

But the question was, whether you have in your calculation taken that into account?—No, we have not.

Have you made any separate account of what that would be?—I should conceive the ground for that purpose would cost either the Gravesend Railway Company or rather the Greenwich Railway Company, the ground that is necessary would amount to about 200,000*l.*, either to be borne by the Greenwich or any other, as the agreement might be.

Where have you calculated those storehouses to be?—On the north side.

On what part of the line do you propose these storehouses should be?—Near Joiners-street.

By the Committee.—On the right hand of the railway?—Yes.

Who does that belong to?—The company that opens into Joiners-street and Duke-street.

By Mr. Rotch.—How high is this railroad?—Fifty-five feet or 56.

You have made no calculation of what the expense would be then?—I should conceive that the extra expense of the ground, of the building; no I have not made any calculation.

What space have you for these carriages to arrive and remain when unloaded; there will be passengers and goods of all kinds arriving every few minutes?—I should propose that more property be purchased for that.

Have you power in your Act to raise money for this additional purchase?—No, we have not.

Then it would be necessary to go to Parliament again?—Yes, it would.

Cross-examined by Sir WALTER RIDDELL.

As this Act is merely a Bill just brought in, it is for the Croydon and not the Greenwich?—The Croydon Company is before Parliament, for power to purchase sufficient land for the stations.

Has that been assented to by the Greenwich Company?—It has.

What will be the extent of that depôt?—The extent of the ground that the Croydon intend to purchase is about 170 feet, I think; I cannot say exactly.

They have bought what they consider sufficient for their own purpose?—Yes.

Have you any agreement with the Croydon as to the conveyance of passengers?—We have an agreement.

It was stated yesterday there was a disagreement?—I do not know of any.

What is the distance of your railroad from London Bridge, where the Croydon passes?—A mile and three quarters.

Have you throughout the whole of your length in that map represented?—Yes.

There are parts there scarcely of any breadth at all; what is marked yellow is the whole of your property?—Yes.

[*To be continued.*]

RAILWAY NOTICES AND INTELLIGENCE.

Railway Maps and Books.—Two very handy maps have been lately published by Wylde of Charing Cross, of different sizes, containing all the railway lines proposed, and in course of execution. They fold up in convenient pocket forms, and the lines appear to be laid in with due care. On the covers are the lengths and costs of the various railways, forming altogether a portable compendium of railway information.

We have received a copy of M. Navier's little work on the means

of comparing different lines of railway, translated from the French by Mr. M'Neil, C. E. It is a useful little work; and we intended this month to make a few extracts from it by way of showing its general character, but have been prevented by a press of other matter.

London, Bedford, and Boston Railway.—A public meeting has been held at Boston, the Mayor in the Chair, to consider the propriety of supporting this Railway and Haven Improvement Company, at which many of the principal inhabitants attended, and a provisional committee was instantly formed.

Railway from Boston to Nottingham.—This railroad will be proceeded in without delay, and no doubt whatever can be entertained of its success. The necessary surveys are now being executed, and applications will be made to parliament at the earliest possible moment.

The Grand Caledonian Junction Railway.—The prospect of this splendid national undertaking being speedily proceeded with brightens.

The practicability of the work is now admitted on all hands, and though the funds necessary for the completion of the undertaking may be large, infinitely less difficulty will be experienced in obtaining them than in raising money to construct a local line, if we may use the term, even though it did not exceed thirty or forty miles in extent.—*Cumberland Paquet, May* 10.

Dublin and Limerick Railway, or second extension of the Great Leinster and Munster Railway.—The spirit of railroad enterprize seems at length to have taken root in Ireland. Our attention has been called to a Report of the above railway. We regret that it came too lately into our hands to be able to consider it minutely; but it appears to be drawn up in a spirit of great fairness and candour, and promises a scheme of considerable utility and advantage to the country and the shareholders. If the section be a fair one, which there seem to be no grounds for distrusting, it must doubtless, at least between Kilkenny and Dublin, be a singularly good and cheap working line.—ED.

Traffic on the London and Greenwich Railway.

February,	persons carried.........	20,412
March	ditto...............	25,465
April	ditto...............	40,492

Jacks in Office.—We have before had occasion to remark upon the petty annoyances offered to the Greenwich Railway Company by the officials of the different Road and Pavement Trusts which the line crosses. Last week Mr. Mackintosh, the superintendent, was compelled upon a summons to quit his duties for the space of some hours, to answer to a complaint of some officious Clerk to a Pavement Board. The dreadful offence was sifting some road stuff a foot or two nearer the highway than the Act specifies. The men were

not aware that they were 'off their ground,' but a small fine was inflicted.

London and Greenwich Railway.—The Prince of Orange and suite, with many of the English nobility, lately visited this splendid work. His Royal Highness, who took his stand on the engine, expressed much satisfaction with the improved carriages, and the precision with which the newly invented break stopped the train.—*Public Ledger, May* 19.

Gloucester and Birmingham Railroad.—We have authority to state, that the reports which have been industriously circulated that it is the intention of the Directors of this Company not to construct the line through Bromsgrove, but to apply to Parliament for powers to make a line by way of Stourbridge, *are entirely devoid of foundation.* The Directors are taking measures to carry into execution the Act which has been obtained, with the utmost dispatch.—*Birmingham Journal, May* 7.

Hull and Selby Railway.—We stated in our last that the difficulties in the way of this Bill had been so far overcome as to relieve us from a great deal of anxiety upon the subject. This favourable view has, we are happy to say, been fully corroborated, and no doubt whatever now exists that the Bill will be eventually obtained. The business, however, proceeds very slowly, and it will be some time before it is decided, as the Committee of Lords, which was to have sat yesterday, was adjourned to Monday.

The adjournment of the House on the 20th for ten days is also calculated to cause further delay.—*Hull Packet, May* 13.

Lancaster and Preston Railway.—Exactly seven times as many shares have been applied for as were at first wanted.—*Cumberland Packet.*

Steam Marriages.—It may be important to state that the Preston and Glasgow Railway passes through Gretna Green. It will be easily possible to travel from London to the forge matrimonial and back again to London on the same day; and what (to the fugitives) is perhaps of still greater consequence in an elopement, the railroad trains cannot overtake each other; so that pursuit will be vain.—*Edinburgh Weekly Journal, May* 18.

The Midland Counties Railway.—A compromise between the opponents and promoters of this line, it is said, has been come to on the following terms: That the Midland Counties Company shall have their Bill, and that the South Midland Counties Company shall apply for *their* Bill next session; the former Company pledging themselves *not to act upon the Rugby line until August* 1837, in order to give time to the Northampton and Harborough line, and the Stamford Branch, to get their Bill passed, if they can; and in the event of their success, to consider whether a junction of interest cannot be effected, and the Midland line be carried by Harborough instead of Rugby.—*Huntingdon Gazette, May* 21.

The mining districts of Northumberland, Durham, and Cumber-

land continue in a state of great prosperity, lead being now nearly £30 per ton, with every prospect of a further increase in price. It is but a short time since that the same article stood at £11 per ton. In one day last week upwards of 2000 pieces of lead came down the Stockton and Darlington Railway for shipment in the Tees, and a similar activity prevails on the Newcastle and Carlisle Railway.—*Carlisle Patriot.*

Newcastle and Carlisle Railway.—In the course of next month this railway will be opened from Hexham to Haydon Bridge, and from Carlisle to Greenhead; so that there will only be about 15 miles between Haydon Bridge and Greenhead to travel by a carriage. When these additional openings take place, the great accommodation of the line to the public will become strikingly evident, inasmuch as the inhabitants of Carlisle may come to Newcastle, and those of Newcastle may go to Carlisle, stay some time, and be at home the same evening. We understand the line between Blaydon and Askew's Quay will be finished in the course of the present year, and a small steam ferry-boat employed for the convenience of the passengers till the new bridge across the Tyne shall be completed.—*Tyne Mercury.*

Northern and Eastern Railway.—Mr. Cundy has settled with this Company, but between them and Mr. Gibbs's Committee the contest still continues.

Railway and Canal Shares.—That railways do not depreciate the value of canal property may be known from the fact that the value of shares in the canals in the immediate vicinity of the most important railways is considerably greater than the value of the latter undertakings. The price of shares in the Manchester and Liverpool Railway, on which £100 was paid, is £290; the London and Birmingham Railway shares, on which £60 was paid, are worth £137; the Grand Junction Railway shares, on which £40 was paid, are worth £124; and the Great Western, on which £10 was paid, are worth £36. The price of shares in the Staffordshire and Worcestershire Canal, on which £140 was paid, is £703; the Warwick and Birmingham Canal shares, on which £100 was paid, are charged at £275; the shares in the Birmingham Canal, on which £17 10*s.* was paid, are valued at £256; and the Warwick and Napton Canal shares, on which £100 was paid, are worth £13 10*s.*—*Lincoln Gazette, May* 17.

Sheffield, Ashton-under-Line, and Manchester Railway.—Another railway is projected under the above name, "which will complete the chain of union with all the large manufacturing towns of England, and bring them within a few hours' journey of each other, uniting the immense and active population of the northern counties with London, Liverpool, and Hull. No opposition is anticipated, and it is presumed an Act may be obtained at a comparatively small expense. The property, to nearly the extent of one half the distance, belongs to two noblemen, who have already expressed opinions favourable to the measure." We believe it is intended to form a junc-

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tion with the North Midland at the nearest point the latter may come to Sheffield, which will greatly add also to its resources. Fifteen hundred shares were subscribed for in Sheffield before the prospectus was issued, and 2000 are now taken in that town.—*Hull Observer, May* 17.

Whitby and Pickering Railway was to be opened May the 26th, and the day to be a general holiday for both towns.

FOREIGN RAILROADS.

Railroads in Belgium.—The opening of the new railroad from Antwerp to Malines took place Wednesday 4th May, amidst the most horrible weather, which, however, did not damp the enthusiasm of the people. The train from Brussels and that from Antwerp met at Malines, whence they both together proceeded to Antwerp, where their arrival was greeted with the loudest acclamations. The King and Queen in a tent received the magistrates who came from Brussels and had joined those of Antwerp. The " experiment," concludes the account, " was highly satisfactory, and we shall henceforth be able to travel the whole distance between the two most important of our cities in one hour."—*Globe, May* 6.

The Frankfort German Journal states that the union of Brunswick with Hanover, and of Hanover with the Hanse Towns and the sea, by means of railroads, will certainly be carried into operation. The total expense of the enterprize will amount to 5,000,000 crowns, which will be distributed in 50 shares to bearers. Duke William has subscribed on his own account for 2,000 shares.

Holstein, April 27.—A rather singular report has been propagated from Gluckstadt, that some English projectors are seeking to find a more convenient channel for the Baltic trade, and for that purpose propose an iron railroad from Gluckstadt to a port in the Baltic, probably Kiel. By this means the roundabout way on the Elbe to Hamburgh (which is already so choked up by sand in many parts near the city that large merchantmen can no longer navigate it) would be avoided, as well as the toll at Stade.—*German Paper.*

Railroads in Prussia.—A letter from Berlin says that the Prussian Government has suddenly changed its opinion with respect to iron railroads, and instead of granting permission to private persons to undertake such works, has resolved to take the matter into its own hands, and to adopt a general plan embracing the whole kingdom, the profits to accrue to the public treasury. It is added that a proposal was made to raise a large loan by the Company of Maritime Commerce.—*Herald, May* 6.

Brussels, May 20th.—Accounts from Cologne and Aix-la-Chapelle bring the satisfactory information that the differences which had arisen between the railway companies of these towns have been settled, and that immediate measures will be taken to proceed to the first opera-

tions, which will be commenced by the construction of the bridges and other works of art. The road will enter the Prussian territory near Eupen, and will run close to Aix-la-Chapelle on the Borcette side, and then stretch away by Duren to Cologne. The Belgic engineers have, it is understood, consented to meet those of Prussia to settle the point of junction.

Brussels, May 14th.—The journey from Antwerp to Brussels by the iron railroad has for some days past been performed in one hour and a half.

Continental Railroads.—A Company is forming for making railroads which will connect Hesse Cassel on one side with Magdeburgh, and on the other with Cologne. A long line from Konigsburg to the Austrian frontier is also about to be commenced. Two railroads from St. Petersburg, one to Zarsko Zelo and Pawlowsk, and the other to Peterkof and Oranierbaum, have been authorized, and are likely to be completed within a year.

PARLIAMENTARY PROCEEDINGS ON RAILWAYS.

May 10th. Birmingham and Bristol, Thames Junction, and Brandling Reports further considered.—11th. Festiniog Report to lie on table; Great Western, Lords' Amendment agreed to; Brandling Junction read third time and passed; Birmingham, Bristol, and Thames Junction read third time and passed; Hayle, Amendments agreed to, Bill to be engrossed; Dundee and Newtyle, ditto.—12th. Hayle, read third time and passed.—13th. Lord George Lennox moved for extension of time to make Report on Brighton Lines.—16th. Brighton Lines, Rennie's and Stephenson's, time to make Report till July 6; South Eastern Dover, reported; Eastern Counties, ditto.—17th. Manchester and Leeds, York and North Midland, North Midland, North of England, Reports further considered, and Bills to be engrossed; Thames Haven to be further considered May 31; Bill to provide for periodical revision by Parliament of tolls and charges, and to make further provisions, to be brought in by Mr. Morrison and Mr. Gisborne.—18th. Royal Assent to Arbroath and Forfar, Great Western, Birmingham and Derby, Ulster, Dundee and Arbroath, Bristol and Exeter, and Aylesbury Bills; Glasgow and Falkirk, Committee to sit and proceed tomorrow; Bills in Committee: London and Blackwall, London and Blackwall Commercial, Manchester and Cheshire Junction.—20th. Royal Assent to Bolton and Leigh; Midland Counties (recommitted) reported; the two Blackwalls, time granted for the Report till June 20; London and Croydon, and London and Cambridge, reported; Newcastle and North Shields, read third time and passed; Durham (South-West), Report to lie on table; Glasgow and Falkirk, further consideration May 30; Edinburgh, Leith, and New Haven, read third time and passed; Tremoutha, Report to lie on table.

PRICES OF RAILWAY SHARES.

800	....	....	Durham Junction	100	10										
2,800	....	....	Glasgow and Falkirk Junction	50	3	3	3	3¾	3½	3	3¼				
			Grand Junction	100	40	107	107	107	107						
			Great North of England	....	2	....	4¼	4	4¼	4	4	4	3¾	3	2¾
			Great Northern	100	2	1¾	1	1⅛	....	1	¾	⅞	....	¾	¾
25,000	....	....	Great Western	100	20	35	36½	36½	35¾	47½	50	49½	49	46	46
2,000	....	....	Hartlepool	100	100	86	80	87½	87½	87½	87½	87½	87½	87½	87½
2,100	....	....	Hull and Selby	50	5	9½	....	....	....	7½	7	7	....	7	7
10,000	....	....	Leeds and Manchester	100	5	25½	23	24½	24	26	....	27	26½	2½	21½
7,000	....	....	Leeds and Selby	100	....										
2,000	....	....	Leicester and Swanington	50	50										
5,100	10*l.* per c.	....	Liverpool and Manchester	100	100										
			Ditto, ¼ shares	25	25										
10,000	....	....	London and Brighton (Stevenson's)	100	5	18	20½	20	19¼	19½	18¾	17½	14¾	14	14
45,000	....	....	——— (Gibbs)	20	1	¾	¾	....	⅞	1	⅞	....	....	⅞	¾
16,000	....	....	——— (Rennie)	50	2	2⅞	2⅛	2	1¾	1⅝	1½	1¾	2⅞	2½	2¾
8,000	....	....	——— (Cundy)	100	2	2¾	2½	2½	2⅜	2⅜	1¾	1⅜	1½	1⅜	1⅜
12,000	....	....	London and Blackwall	50	3	4½	4⅜	4⅜	4⅝	3⅛	3¾	3⅝	3½	3⅜	3¼
			London and Dover	50	1	....	⅞								
30,000	....	....	London and Gravesend	20	1	....	⅞	¾	⅝	....	¾	¾	¾	....	⅞
20,000	3*l.* per c.	Ap. & Oct.	London and Greenwich	20	20	28	28	27½	27	27½	27½	28¼	28½	28	27
			Ditto, Bonds.												
25,000	....	....	London and Birmingham	100	60	....	138½	139½	....	137½	136	138	138	137	134
20,000	....	....	London and Southampton	50	20	29	29	29	28	28	28¼	28¼	27½	27½	25½
7,000	....	....	London and Croydon	20	5	6½	....	....	....	5¾	5	4⅞	5¼	5	
12,000	....	....	London Grand Junction	50	2	4⅛	4½	4	3½	4	3	3¼	3	3	2¾
1,000	....	....	Manchester and Oldham	100	3										
10,000	....	....	Manchester South Union	100	2	5¼	5¼	5¼	4¾	5¼	4¼	4¼	4½	4	4½

PRICES OF RAILWAY SHARES (Continued).

Number of Shares.	Dividend per Ann.	When Dividend due.	NAMES OF RAILWAYS.	Amount of Shares.	Sum Paid.	Closing Prices of Shares in London Markets on: April 26.	April 29.	May 3.	May 6.	May 10.	May 13.	May 17.	May 20.	May 24.	May 27.
				£.	£.										
			Midland Counties	50	5	....	10	9	8¼	....	8¼	7½			
			Margate and Ramsgate	....	2	2¾	2½	2¾	2¾	2¼	2¼				
			North Midland	....	5	13¼	13¼	13½	15	12¾	13	13	13¼	13	13¼
			Northern and Eastern	100	3	4¼	4¾	4¼	4¼	5¼	4¼	4	4	3¼	3½
2,500	....	....	Preston and Wigan	....	20										
2,600	....	....	Preston and Wyre	50	3	....	....	11	....	10					
4,000	....	....	Sheffield and Rotherham	25	3½										
1,000	6l. per c.	....	Stockton and Darlington	100											
1,500	....	....	Stanhope and Tyne	100	100	92½	92½	92½	....	105	105	105	105	105	105
3,000	....	....	South Durham	50	2½	5	3	4¼	4¼	....	3¼	....	3½	3⅛	
28,000	....	....	South-Eastern	....	2	6½	7	8	8	7	6	6½	6	5	4½
			South Midland	50	1	1¾	1¼	1¼	1¼	1	¾	¾	¾	....	¾
40,000	....	....	South-Western	50	1	1¼	1¼	1¼	1½	....	1	....	⅞	¾	
9,000	....	....	Thames Haven	50	2½	2¾		....	....	1¼	2	2	2¼	1¾	2⅝
6,600	....	....	Victoria	25	1	....	....	1¼							
			Warrington and Newton	100											
6,000	....	....	York and North Midland	50	1	5¾	5¼	5½	5	4¾	4½	4¼		4	

The above, as we have e closing prices of the day. They are the prices at the last business transactions. But it is to be understood that there is ference of ¼ in the Stock Exchange between the prices a person can sell at and those he can buy at, the former being less than the latter. The prices obviously include the sum paid for the Share; and therefore the difference between them and the price paid on the Share is the premium or discount of the Share. Where there are blanks no business was done. We have carefully corrected the list of the Number of Shares wherever we could; but should any errors be left we shall immediately correct them when pointed out.

THE RAILWAY MAGAZINE;

AND

Annals of Science.

No. V. JULY, 1836. NEW SERIES.

MATHEMATICAL LAWS OF RAILWAY TRANSIT.

BY THE EDITOR.

BEFORE I proceed with the continuation of the paper in No. II. on the Laying out of Railways, it is needful to lay down the Laws of Locomotion, to which we may have to refer.

On the Motive-Power of Locomotive-Engines.

Every one knows that the principles of motion in locomotive-engines are, the force of the steam on the piston to turn the wheels, and the resistance of the materials on which the wheels roll to prevent their sliding or slipping round. It is therefore the excess of the steam-power to turn the wheels above the slipping resistance, which generates progressive motion; and the amount of this resistance, which measures the intensity of traction, or determines the weight that can be drawn. Hence friction—that enemy to ideal perfection in machinery, and stumbling-block to the wanderers after perpetual motion—becomes here our best friend and coadjutor. Without friction, indeed, the almost omnipotent power of steam would be useless and valueless.

Let b = the bite on a level plane;
t = the force of traction on ditto;
z = the angle of inclination of any plane;
w = the weight on the working wheels;
W = the weight of load and engine.

Then $b\,w$ = the total bite or force of traction when the engine is doing its best on a level; and $b\,w \cos z$ = the same in an inclined plane. But $W\,t$ = the force of traction on a level due to the rolling friction; and $W\,t \cos z$ that on the inclined plane. If this, therefore, be augmented by the effect

of gravity $W \sin z$, pulling the load down the plane, the sum $W t \cos z + W \sin z$, is the force of traction wanting to maintain motion up the inclined plane; and, consequently,

$$b\,w \cos z = W\,(t \cos z \pm \sin z). \quad\text{..............(1)}$$

Now, if the inclination was 1 in 23, or near 230 feet per mile, the error of making $\cos z = 1$ would be less than 1 in 1000; and therefore, for all practical purposes, we may safely assume $\cos z = 1$, which reduces the expression to

$$b\,w = W\,(t \pm \sin z). \quad\text{.....................(2)}$$

By knowing any four of these quantities, the fifth may be found. For instance, the greatest multiple of the weight on the working wheels, which can be kept in motion on a horizontal plane, is $\frac{W}{w} = \frac{b}{t}$; and the greatest inclination which can be ascended is found from $\sin z = \frac{w}{W} b - t$.

The general estimate of the force of traction on a level railway is 8 lbs. to a ton; if, therefore, we take 8 lbs., which gives $\frac{1}{280}$th, we cannot err much. This being settled, the following experiment on the Runcorn and St. Helen's Railway, April 11, 1834, will afford us the means of determining the value of the bite:—An engine called the "Director," $9\frac{3}{4}$ tons, with coupled wheels, dragging her tender $3\frac{1}{2}$ tons, and two wagons of coal $13\frac{1}{2}$ tons, started from a little way below the commencement of a plane rising for some distance from the bottom 1 in 30, and near the top 1 in 26. On the engine were two men, and on the tender myself and two others, as far as I remember. One of the men held the escape-valve firmly down, which enabled us slowly to reach the summit; but it was evidently a maximum effort. Presuming the weights and inclination to be right, we have $W = 9\frac{3}{4} + 3\frac{1}{2} + 13\frac{1}{2} = 26\frac{3}{4}$, $w = 9\frac{3}{4}$, $\sin z = \frac{1}{26}$, and, as before, $t = \frac{1}{280}$. Consequently,

$$b = \frac{26{\cdot}75}{9{\cdot}75}\left(\frac{1}{280} + \frac{1}{26}\right) = \frac{1}{8{\cdot}67}.$$

But, if we suppose the two wagons to be only 10 tons, no more than which I have since been assured they were, $W = 23\frac{1}{4}$ and $b = \frac{1}{9{\cdot}87}$, or, in round numbers, $\frac{1}{10}$th, which I have reason to believe is a reasonable estimate of the bite in most cases; for the weather was not good when the experiment was made. It also agrees very nearly with another ex-

periment on the Sutton inclined plane I attended, made with the "Etna" engine, and a train of loaded wagons. Consequently, $\frac{1}{10} \div \frac{1}{280} = 28$ times the weight on the working wheels, which is what an engine can draw on a horizontal line generally. In some cases it may draw, probably, as much as 40 times that weight from the superior bite or adhesion of the wheels.

Hence, if $W = w$, we have $\sin z = b - t = \frac{1}{10} - \frac{1}{280} = \frac{23}{280}$ $= \frac{1}{10\frac{1}{2}}$ nearly; that is, the maximum inclination which a locomotive-engine could ascend without any weight attached, having coupled wheels, and in a medium state of the rails, would be an ascent of about 1 in $10\frac{1}{2}$.

Effect of the Weather on the Adhesion or Bite of the Wheels.

This bite varies much with the weather and state of the rails. Generally, the upper surface of the rails is covered with a thin coating, compounded of dust and oxide of iron, presenting in dry weather that iron glassy appearance which we see where horses have slid about in the London streets; and which, at first view, impresses one with the idea that such a surface could furnish but little hold for the wheels of the engine. However, in dry weather, the coating is hard and firm; and though I suspect the bite is then not so great, yet as the surface is at the time smoothest, the rolling friction is probably a minimum, which makes up for the difference, and causes the rails to work so well. In very wet weather the coating is perhaps nearly washed off, or so liquefied, as to permit the surfaces of the wheel and rail to come into immediate contact. By this means the bite may be somewhat augmented, and probably the friction too, by the imperfect liquefaction of the coating. These two circumstances combined may be the cause that in very wet or very dry weather the rails work equally well. But when a little wet has weakened, without destroying, the tenacity of the coating, it will form a series of rollers, like grease between the wheel and the rails, thereby diminishing the bite, while, yielding to pressure, it will present a continued obstruction to the wheels, and hence increase the rolling friction of the train. In this case, the effective action of the engines will be extremely enervated; and, of course, the velocity of the train considerably impeded. I was informed the trains had, in this way, been occasionally reduced to a stand-still, when ascending the inclined planes.

In one instance, I myself saw two engines with seventeen loaded wagons creeping up the Whiston plane, after a little wet, at a rate of scarcely three miles an hour; and if it had not been for two men seated on the front arms of the first engine, dropping sand incessantly on the rails before the engine, it appeared evident to me they could not have gone up at all. I also observed that the trains invariably travelled much slower, and with more difficulty, early in the morning, before the dew was off, than later in the day. The difference in the time of transit amounted to a quarter of an hour or twenty minutes, though the loads were very nearly the same, and the slower train had the advantage in point of road, that is, in going from Liverpool to Manchester, which is easier than from Manchester to Liverpool.

I hope I shall be pardoned for saying so much on this part of the subject; but it is one of such paramount importance in the mechanical operation of railways, that I could not lightly permit it to pass. Next to the improvement of the engines, it demands the deepest attention; for it is lamentable that a heavy dew, or a little rain which would scarcely lay the dust, or a little snow which would disappear the moment it fell, should be able to paralyse one of the noblest of modern inventions. A remedy, however, I think it would not be difficult to find.

Force of Traction.

By (2) we immediately get the force of traction, supposing the engine to add no extra friction from the working of its machinery, a supposition which, in the present case, may safely be admitted. If, then, we suppose the load $W = 1$, and divide the expression by $t = \frac{1}{280}$, and put $z = \frac{h}{5280}$, h being the number of feet of perpendicular elevation in a mile, we shall have

$$1 \pm \frac{h}{19} \text{ nearly} \ldots\ldots\ldots\ldots\ldots\ldots(3)$$

for the force of traction, h being plus in ascending planes and minus in descending, and 1 being the force of traction on a level. By this theorem, it appears that the plane of repose, as it is sometimes called, that is, that plane in which, mathematically speaking, the least force would retain the train in a state of rest or set it going, is about 19 feet a mile inclination. When h exceeds 19 in a descending plane, the force is evidently not a tractive or drawing force, but a resisting force, opposing the motion of the train.

It was from this theorem that the sixth columns of exertions in the table at page 95 were constructed, to correspond with the fifth columns of the rises and falls. We shall hereafter see why in this table the descents are not carried beyond a fall of 11 feet per mile. Of course this force is independent of that necessary to overcome the resistance of the atmosphere. It is likewise constant for all velocities; that is, it is the same unvaried quantity, whatever be the velocity, provided it be uniform. When the velocity is increasing the force of traction is greater, and when decreasing less, than is given by (3), presuming the inclination of the plane and other things to remain the same.

The Practical Rule for computing the force of traction free from symbols and decimals is, *Multiply the rise or fall of the plane in feet per mile by* 100, *divide the product by* 19, *and if the plane be an ascending one add, but if a descending one subtract, the quotient from* 100, *and the sum or remainder will be the force of traction, supposing it on a level to be* 100. If it is wanted in lbs., *Multiply the number just found by* 8 *times the number of tons in the whole train, engine, and tender, and divide the product by* 100. Or, *Multiply the number in the sixth column of the table page* 95, *corresponding to the rise or fall in the preceding or fifth column, by* 8 *times the number of tons in the whole train, and the answer will be the traction in lbs.*

Thus: Suppose the load be 150 tons, and the plane rise 76 feet per mile; then by the table 76 gives 5, which, multiplied by 8 and 150, makes 6000 lbs. for the traction. I have been induced to give these rules in words at length at the request of some civil engineers.

[To be continued.]

POWER OF STEAM KNOWN TO THE ANCIENTS.

By D.

To the Editor of the Railway Magazine.

Sir,

Among the numerous competitors for the honour of having first suggested steam as a moving power in mechanics, writers on the subject have made principal mention of Hero of Alexandria, Brancas, and our countryman the Marquis of Wor-

cester, as occupying the foremost rank. I was therefore naturally pleased on finding a palpable allusion to steam power as resorted to in the sixth century; and as I do not remember to have seen it noticed by recent authorities, I transcribe the passage for insertion in your pages, if in your judgement it merits publication there. Your readers will please to refer for the original to Gibbon's Decline and Fall, vol. vii. p. 114. 8vo edition; and they will bear in mind that when that historian mentions the effect produced as caused by "the efforts of imprisoned air," he wrote at a time when the immortal Watt had not yet rendered familiar to the world the stupendous properties of elastic vapour.

I am, Sir,
Your constant reader,
Deptford. D.

A citizen of Tralles in Asia had five sons, who were all distinguished in their respective professions by merit and success. Olympus excelled in the knowledge and practice of the Roman jurisprudence. Dioscorus and Alexander became learned physicians; but the skill of the former was exercised for the benefit of his fellow-citizens, while his more ambitious brothers acquired wealth and reputation at Rome. The fame of Metrodorus the grammarian, and of Anthemius the mathematician and architect, reached the ears of the emperor Justinian, who invited them to Constantinople; and while the one instructed the rising generation in the schools of eloquence, the other filled the capital and provinces with more lasting monuments of his art. In a trifling dispute relative to the walls or windows of their contiguous houses, he had been vanquished by the eloquence of his neighbour Zeno; but the orator was defeated in his turn by the master of mechanics, whose malicious, though harmless stratagems, are darkly represented by the ignorance of Agathias. *In a lower room Anthemius arranged several vessels or cauldrons of water, each of them covered by the wide bottom of a leathern tube, which rose to a narrow top,* and was artificially conveyed among the joists and rafters of the adjacent building. *A fire was kindled beneath the cauldron; the steam of the boiling water ascended through the tubes; and the house was shaken by the efforts of imprisoned air,* and its trembling inhabitants might wonder that the city was unconscious of the earthquake which they had felt. At another time the friends of Zeno, as they sat at table, were dazzled by the intolerable light which flashed in their eyes from the reflecting mirrors of

Anthemius; they were astonished by the noise which he produced from a collision of certain minute and sonorous particles; and the orator declared in tragic style to the senate, that a mere mortal must yield to the power of an antagonist who shook the earth with the trident of Neptune, and imitated the thunder and lightning of Jove himself.

CALCULATIONS ON THE TIMES, &c. OF TRANSIT ON THE SOUTH-EASTERN DOVER LINE.

By Mr. John Bravender.

To the Editor of the Railway Magazine.

Sir,

Having for several years devoted my leisure moments to extend and improve as much as I could the theory of road engineering, I feel great pleasure in finding that you are *now* prepared to receive notices on scientific subjects generally, and such opportunity offered to your correspondents has produced some calculations with which I was much gratified. In your last Number a person who has adopted the name of "Detector," has given in his letter a table purporting to show the time it will require to travel from Croydon to Dover and back on the proposed South-Eastern line of Railway. As is my usual habit when I meet with such calculations I attempted to verify his results with calculations from a theorem of my own*, and found we did not agree; and therefore beg to trouble you with my calculations. In doing this I beg to state that I have no knowledge of the railway in question but from what is conveyed in Detector's letter, and that I have no feeling either for or against it. My sole object is truth and extension of a knowledge of the theory of railways and locomotive engines, and therefore should Detector feel annoyed at my interfering with the subject he has in hand, I at once disclaim altogether any intention on my part to excite controversy or wish to give offence. The calculations I have made may be tabulated as under.

* Had our correspondent given us this theorem, we could judge perhaps of its value.—Ed.

Expense of Transit from Croydon to Dover and back.

Distance in miles.	From Croydon to Dover.		From Dover to Croydon.		Distance in miles.	From Croydon to Dover.		From Dover to Croydon.	
1·14	53·35			−12·31	3·98	53·04		54·23	
1·75	107·10			−44·10	2·00	36·00		36·00	
1·19	54·97			−12·13	1·00	23·60		12·04	
·71	23·50		3·62		·11	4·43		......	−·47
2·00	61·80		10·20		7·69	189·94		86·89	
1·85	8·69		57·90		1·10	27·83		11·77	
1·64	......	−40·18	99·22		1·56	28·44		28·44	
8·55	49·59		258·21		2·99	83·12		24·51	
3·32	31·20		88·31		6·51	195·95		38·40	
2·68	46·63		49·84		1·56	......	−39·31	95·47	
3·78	30·61		105·46		1·89	8·50		59·53	
1·46	26·08		26·08		5·62	101·16		101·16	
3·13	63·53		49·14		9·5	......	−7·33	41·51	
	557·05	−40·18	747·98	−68·54		1309·06	−86·82	1337·93	−69·01*

In passing from Croydon to Dover there will be an expenditure of 1309·06 and a loss of 86·82, making together 1395·88, from which take 1245·96, the expenditure of a level railway 69·22 long, and we get 149·92, which is equivalent to 8·33 miles of level railway; which indicates that a level railway of 8·33 miles longer than the proposed one would be worked with the same expenditure as the one between Croydon and Dover; that is, if this railway were level and extended in length to 77½ miles, it would then be as œconomical as the one proposed of 69·22 miles. In the same manner we shall find that in passing from Dover to Croydon the 69·22 miles will with the proposed ascents and descents cause as much expenditure as passing along a level line of 78·16 miles, and the times of passing and repassing on both would be equal. Hence in travelling from Croydon to Dover it may be said to be 77·55, and back again 78·16 miles of level railway. The negative values in the tables are considered as a portion of the expense, because when they occur the planes are so steep as to require brakes, which destroy the power from which those values are derived; and on planes where it is necessary to destroy power, it is the same with regard to its cost of production as if it

* We have made computations ourselves very different from these, and from a theorem which we think we can rely on; but as a bill to make the South-Eastern line is now become part of the law of the land, we do not wish to furnish gratuitous discouragement to the execution of the project.—Ed.

were actually expended in producing motion. But as regards the time of transit I am of opinion that such values ought not to be brought into calculation, because in descending the planes of greater fall than about 1 in 240, the gravity of the engine is prevented from operating with its full force by means of contrivances for the purpose.

The time in passing from Croydon to Dover will be $3^h\ 1^m{\cdot}8$, supposing the velocity on level railways to be 24 miles an hour, and the time on a level of 69·22 miles will be $2^h\ 52^m{\cdot}8$: whence $3^h\ 1^m{\cdot}8 - 2^h\ 52^m{\cdot}8 = 0^h\ 9^m$, the difference, or loss of time. And the time in passing from Dover to Croydon will be $3^h\ 5^m{\cdot}8$, whence $3^h\ 5^m{\cdot}8 - 2^h\ 52^m{\cdot}8 = 13^m$, the difference, or loss of time in returning. The times thus found do not agree with those given by Detector, principally because he compared a velocity of 30 on a level with 24 on a railway that is not level, but composed of rapidly ascending and descending planes. From the above calculations we find that a trip from Croydon to Dover and back will occupy 22 minutes longer than on a level of the same distance, and which will be effected at an additional expense of $169{\cdot}92 + 160{\cdot}98 = 310{\cdot}90$, which is equivalent to the whole locomotive expense of a level railway of 17·27 miles in length.

I am, Sir, your obedient servant,
JOHN BRAVENDER.

Cirencester, April 18th, 1836.

A PLAN FOR PREVENTING ACCIDENTS ON RAILWAYS.

By Mr. Thomas Calver.

To the Editor of the Railway Magazine.

Sir, *Chelmsford, May* 5, 1836.

You will extremely oblige by inserting in your Magazine a short description of a plan for preventing accidents by breaking of axletrees of engines or carriages on railways. I beg leave to submit to the proprietors, &c. of such concerns, that if the carriages were joined together at their corners, so as to leave sufficient play by suitable bolts, links, screws, &c. in any way they might most approve of, then should any axle break, that corner would be supported by the joining corner of the next carriage; and for the *front* of the engine, and the

back of the last carriage, each to be provided with an extra pair of wheels, not quite touching the rails; and to prevent the wheels, when broken off, from falling on the rails, &c., I propose that they may in such case be kept in their places by a collar, nearly fitting each end of the nave, each supported by an arm, projecting from and fastened to the carriage, sufficiently strong to support the wheel in its place, should the axle be broken, till the train may be stopped and the wheel removed, when the journey may be finished without it by moderating the rate of travelling, &c. Judging this to be calculated to give full confidence to the public, and consequently to be highly beneficial to all proprietors of railways, I hope to receive from them some suitable reward should they adopt this plan, and find it advantageous and profitable.

Yours, &c.,

THOMAS CALVER.

Marriages Square, Chelmsford, Essex.
May 5, 1836,

OBSERVATIONS ON THE EXPLOSION OF STEAM-BOILERS.

BY JACOB PERKINS, ESQ.

To the Editor of the Railway Magazine.

SIR,

A SERIES of experiments to discover the cause of the explosions of steam-boilers has been ordered to be made by the Secretary of the Treasury of the United States of America. The Franklin Institute was selected to make the experiments: they certainly spared no pains in their researches; but for want of some practical facts which have transpired in the course of the experiments which I have made within the last ten years, they have come to a conclusion, in my humble opinion, entirely fallacious, and will if not controverted very much injure the cause of science. The most dangerous conclusion which they have come to is, that all the destructive explosions of steam-boilers have been caused by the direct pressure of the steam; and that there is no difference between the explosion and the bursting of steam-boilers. If the late Oliver Evans (who was one of the greatest men America ever produced,) had been living, he could have told them a very

different tale. Mr. Evans had a record of more than 600 bursts before he had one explosion, although the pressure was greater when the bursts took place than when the explosions happened*. I have myself witnessed enough to be perfectly satisfied that there is as much difference between a burst and an explosion of a steam-boiler as there is between the bursting of a cannon by hydraulic pressure or by gunpowder. It is well known that a cannon burst by hydraulic pressure is perfectly harmless, and it is also known by dreadful experience the effect of bursting with powder. In my endeavours to learn the nature and value of high steam I have been so fortunate as never to have had one explosion, although

* It has often been observed that just before one of these tremendous explosions has taken place, the engine worked more sluggishly than common, indicating that the explosion was caused by sudden generation of high steam, or by an explosive mixture having been formed in the boiler. I have no doubt that there are three kinds of explosion.

The *first* and most common cause is from the pressure of common steam. What is meant by common or pure steam, is such as has not been suddenly elevated, or such as has not been compounded with an explosive mixture, by the improper management of the boiler.

This first kind of explosion is quite harmless, as the boiler simply rends or gives way in the weakest place, which is caused from wear or some defective spot. The *second*, which I some years since accidentally discovered and published, arises from the water getting too low in the boiler. The fire then impinging on that part of the boiler which is above the water, causes the heat to be taken up by the steam, which rises by its superior levity to the top of the boiler, causing it sometimes to become red-hot, and so elevating the steam to a much higher temperature than its pressure would indicate. Now, when the boiler is in this state, and the safety-valve suddenly raised, the water will be relieved from the steam pressure, and rush up amongst the surcharged steam, which thus receives its proper dose of water; at the same time, that part of the boiler which has been raised in temperature giving off its heat to the water so elevated, steam is generated in an instant, of such force as no boiler can resist. This kind of explosion has of late years been very frequent and disastrous, particularly in America.

The *third* and less frequent kind, although most terrific, is undoubtedly caused by an explosive mixture having been formed in the boiler. It has long been known that hydrogen has been often liberated by the boiler being overheated by improper stoking, as well as not being properly supplied with water; but simple hydrogen cannot explode,—and where it could get its atmospheric air, which is absolutely necessary to form the explosive mixture, it has been difficult to understand. We have only, however, to look at an air-drawing feed-pump, and the source will be readily seen. It is frequently the case that the feed-pump draws air as well as water, arising from its unsoundness, &c. The more air the pump draws, the less water is forced into the boiler; of course the boiler is more and more exposed to the fire, and the heated parts of the boiler become oxidized, and rapidly liberate hydrogen; and as sufficient air has been pumped into the boiler to form the mixture, it will be ignited by an overheated part of the boiler, and the tremendous effect can only be equalled by an explosion of gumpowder.

I have very often had the steam up to 100 atmospheres pressure, but I have had more than 100 rends or bursts.. In the Adelaide Gallery, where the steam has been up daily to an average of 450 pounds to the inch for more than four years, and where many times the exhibition of the steam-gun has been stopped in consequence of the bursting of the generator, yet no one heard any report, although many were within a few feet of the generator. In fact, I never knew a brick to be disturbed by the bursting of the generator. About ten years since I was exhibiting the steam-gun to a great crowd, when in the middle of a volley, the steam dropped, and the balls refused to leave the barrel. I immediately ran to the furnace, and found a rend about eight inches long and one inch wide in the centre of the boiler, which was three and a half feet long, seven inches diameter, and three quarters of an inch thick, of wrought copper. Having apologized to the company for being obliged to stop the experiment as the boiler had burst, they exclaimed that it was impossible, for they heard no explosion; my answer was, "Come and see," which many did, when to their astonishment as well as pleasure, they found that the rend was very great. One gentleman in particular was extremely gratified at being present when the occurrence took place, he being an owner of steam-engines.

One of the experiments of the Committee was, "to ascertain whether intensely heated and unsaturated steam can, by the projection of water into it, produce highly elastic vapour." Abut eight years since I published a treatise on the cause of explosion of steam-boilers which found many believers. The Committee of the Franklin Institute have been making experiments to ascertain whether surcharged steam could have its power increased by adding sufficient water to give to it its proper density. My experiments, however, to prove the fact were conducted in a very different manner from those of the Committee. I built my fire under the bottom of a very strong generator, which would bear at least a pressure of 300 atmospheres.

The object of this great strength of the generator was not only to enable me to make my experiment without danger, but to surcharge the steam at a very high temperature, so that there should be no mistake as to the result. The fire was made at the bottom of the generator, about a quarter up the sides, and about as much above the water as below it, observing at the same time to have the fire much more intense above the water than below the steam; but no fire was

made *on* or *near* the *top* of the boiler, believing that heat would not descend any more in steam than in water. (This fact is now completely established by a new modification of a boiler, which owes much of its success to the property which surcharged steam possesses in transmitting heat, the particulars of which cannot be made public until I have obtained my foreign patents.) If I had made my fire on the top of the boiler, as was done by my countrymen in their experiments, I should have made the same mistake which they did, and instead of surcharging the mass of steam, I should only have surcharged a small film next the heated metal, and left the rest perfectly saturated with water, and quite unfit for receiving a jet of water, which could only serve to lower the temperature and power, which was the case in their experiments. At the top of my generator the temperature was at least 3000 degrees, ascertained by an alloy that fused about that point; the temperature of the steam in contact with the water was about 300 degrees, the mean temperature about 1500 degrees: that, together with the heated sides and top of the generator, furnished heat enough to make the indicator rise at each stroke of the pump from 50 to 100 atmospheres; and as the steam was constantly blowing off at the safety-valve, which was loaded at 5 atmospheres, the steam would fall to that pressure in about 15 seconds. The oscillation of the indicator was from 4 to 5 times per minute; its rise was instantaneous, but its fall gradual.

The ninth experiment of the Committee was, "to repeat Perkins's experiments, and ascertain whether the repulsion stated by him to exist between the particles of intensely heated iron and water be general; and to measure, if possible, the extent of this repulsion with a view to determine the influence which it may have on safety-valves. The experiments made with the perforated thick iron bowls, as far as they went, were very satisfactory. The water standing in the bowl heated up to 800 degrees without passing through the metal, until the metal had lowered its temperature, would be easily seen by any one, and would be an interesting one to be repeated in a lecture room.

"The Committee now proceed to give an account of an unsuccessful attempt to repeat Perkins's experiment referred to in the query. As it does not seem to bear upon the application of the safety-valve, they did not deem it necessary to encounter the expense of the apparatus necessary to a further trial."

[To be continued.]

ON PARLIAMENTARY PROCEEDINGS UPON PRIVATE BILLS.

Every succeeding session of Parliament adds new and increased importance to this subject, and, as yet, the attention of the public in general has never been directed to it. Indeed, with the exception of the solicitors, parliamentary agents, and other individuals, whose business it is "*to get Bills through the House*," few persons are acquainted with the mode in which the proceedings upon private bills are conducted, and none care to inform the public upon a system which works with great advantage to the limited number connected with it. Knowledge is power; and so long as the power thus conferred is restrained within bounds, the pursuit of such knowledge is confined to the few persons whom accidental circumstances in the routine of life direct in its track. But the public are now sore pressed, by reason of their own ignorance. It is high time that the veil of obscurity in which the private branch of our legislation has been enveloped should be torn aside, and that the public should gaze upon a system, of the effects of which they are alone sensible, but the operation of which is less known, though far more visible to them, than the operation of the powers which cause the various forms of material substances with which we are surrounded.

From the passing of Magna Charta till the reign of Richard III., no distinction appears to have been made between public and private acts, and the statutes contain but a very few enactments of a private nature during that period. In the first year of the reign of Richard III. (1483), a classification of the statutes took place into public acts and private acts; and from this era we may date the importance which the latter gradually assumed. The private acts which were passed at that time, and from thence during a considerable period, were strictly of a personal and individual character and application; such as acts for attainders, and for the reversal of attainders; acts for the confirmation of letters patent, for the enjoyment of lands; acts for restitution, and for granting subsidies to the king; acts for individuals, chiefly the nobility of the kingdom, for the assurance and settlement of their estates, or validation of their marriages, naturalization bills, &c. In course of time, the private bills, in addition to those before mentioned, assumed a new and more extended character, affecting not only individuals, but large classes of persons, and extensive districts, such as inclosure and allotment, road,

harbour, navigation bills, &c., so that in the year 38th George III. (1797), a new classification of the statutes was made into 'Public General Acts,' 'Local and Personal Acts,' and 'Private Acts.' This arrangement lasted till the 43rd George III. (1803), when the title of the statutes for that and the following year was changed to 'Public General Acts,' 'Local and Personal Acts to be judicially noticed,' and 'Local and Personal Acts not printed.' With the addition to the title of the second class of acts, that 'Printed Copies of the same might be given in Evidence,' this classification lasted till the 54th George III. (1814), from whence, up to the present time, the statutes have been divided into 'Public General Acts,' 'Local and Personal Acts,' declared public, 'and to be judicially noticed,' 'Private Acts printed by the King's Printer, and whereof the printed copies may be given in Evidence,' and 'Private Acts not printed.'

Thus in the earlier portion of our civil history, the private branch of our statute law has received no distinct legislative notice from that branch which is of a general tendency. The subsequent separation and classification of private enactments at once shows the character and importance which belong to them, and the order in which that classification has been made evinces their degrees of public interest and relative connexion with the public weal. But although this branch of parliamentary legislation has assumed the important features which it now presents, and as the nation advances in wealth and civilization, those features are still more strongly impressed upon it, in the increasing number of the highest class of private enactments, 'the Local and Personal Acts which are declared Public, and to be judicially noticed,' possessing in their operation and effect more importance than many of 'the Public General Acts,' the system upon which this branch of parliamentary legislation is conducted has scarcely been thought worthy of public attention, and has certainly never been regarded with that degree of interest which ought to be bestowed upon it.

The standing orders and resolutions of the House of Commons exercise but a very slight and imperfect control over the parliamentary proceedings upon private bills. These orders have been made, from time to time, as private bills have had a more extended operation and general tendency, and as the liberty of person and the rights of property have become better respected, with the intention it would seem that neither the one nor the other should be infringed, unless for the public good; but they have little or no operation be-

yond the regulation and establishment of the routine of practice to be observed upon passing private bills through their different stages, and aid but in a very small degree the great principle of legislation, to which such rules of practice are, or ought to be, merely ancillary and subservient. It is foreign to our purpose, now, to canvass the merits of these standing orders; but we should not be deemed presumptuous, were we at once to question their propriety and fitness, since a Select Committee* of the House of Commons has recorded "that they are deeply impressed with the necessity of their being fully and attentively revised." These standing orders and resolutions, however, it must be remembered, useless and inadequate though they may be, form the basis of legislation upon the private branch of our statute law, and contain the only checks which the wisdom of Parliament has thought fit to place upon its proceedings.

We have before traced the rise and progress of the private branch of parliamentary law into the triple classification of its Acts, under the different titles which they now bear. The class which bears the title of 'Private Acts,' contains chiefly the bills which are passed for private relief, such as naturalization and divorce bills, and bills for the settlement of estates and property, in cases in which the ordinary courts cannot give relief, or in which the wishes and intentions of the parties for whose relief they are introduced, cannot be effected under the ordinary assurances of the law. In the circumstances giving rise to these bills, there are few, or none, conflicting interests; and such as may exist, arise and are reconciled between the parties to such bills themselves, so that the duties and functions of parliament upon this class of bills are scarcely more than ministerial; and the bills pass through their different stages into law as a matter of course, framed and fashioned by the parties themselves, in the manner best suited to effect the object of their introduction. These formal acts of the legislature, for some years past, have scarcely increased in number. Many difficulties and contingencies now arise, in dealing with property, for which an application to parliament would formerly have been necessary; but which, under various acts of the legislature, are now referred to other tribunals, and there settled, without the necessity of legislative intervention. To this cause we may refer the paucity of bills contained in this class, and there is little doubt but that

* The Select Committee appointed to report upon Railway Bills at the commencement of this Session.

parliament might in the same manner be relieved of a still larger portion to great advantage.

Between this class, however, and the other two classes of Private Acts, and particularly that which bears the title of "Local and Personal Acts declared Public, and to be judicially noticed," a great difference exists. In this latter class are contained the Acts under which the great undertakings, which national or individual enterprise can dictate, are carried into execution; such as some of the principal Inclosure and Turnpike Road Acts, acts for the formation of Docks, Piers, and Harbours, Bridges, Tunnels, and Railways, and acts passed for the various purposes of municipal government, and regulations of towns. The Bills which are introduced to effect these measures affect a large portion of the community, and from the magnitude of the interests which they have at stake, are invested with a character of not less than national importance. Many of the Bills which are placed in this class of Private Acts, and the measures which originate them, require of the legislature a degree of zealous attention, careful and attentive consideration, acute perception, and, above all, the most rigid and impartial investigation and decision that can possibly be applied to any measure, in which the rights and liberties, and the comforts or happiness of the community are at stake. In the remarks then which we may make, it should be understood that they apply chiefly to the class of private bills lastly mentioned, as they alone are of interest to the public at large.

The undertakings which give rise to this class of Bills are generally, in the first instance, the schemes of individuals, who set them on foot and labour to accomplish them with different motives, but of which personal gain is the most predominant. To execute and complete any measure of this description its promoters must be clothed with various and extensive powers, which an act of the Legislature only can confer. An Act of Parliament therefore must be obtained. The first step towards it is to present a petition to the House of Commons, alleging that the undertaking is of *great public benefit*, and this petition is the groundwork for the subsequent parliamentary proceedings. Leave to bring in the bill is obtained as a matter of course. Amongst the parties personally interested in the undertaking are perhaps several members of parliament, and others whose station in the country, either in rank or opulence, gives them a weight and influence in the House of Commons hardly secondary to that possessed by the members themselves. The bill is introduced, and read a first time. After this stage is passed, every exertion, argument,

and misrepresentation too, is used by those who are personally interested either for or against the measure, to induce the *disinterested* members of the House to pass or reject the bill at the second reading. The bill however is read a second time, and committed. By this time many members, who upon the introduction of the bill were disinterested, have now enlisted themselves decidedly in favour or in opposition to it. The members on each side are alone the *constant* attendants in the committee. Evidence is adduced on either side, for or against the bill. Examinations, cross-examinations, and re-examinations take place, conducted by learned counsel, aided by the *Honourable Members* for either party, all striving to elicit just those answers which may give a favourable colouring to that side of the question which they respectively support. The several clauses of the bill are gone through, upon many of the most important of which (to compare small things with great) a contest and division similar to that which ensued upon the second reading of the bill takes place. The bill has been gone through; new clauses, upon which similar contests and divisions ensue, are added to the bill. The report of the committee upon the bill is made to the House, which report of course savours pretty strongly of the predominancy of feeling in the body from which it emanates. Then follows the consideration of the report, the third reading of the bill, and with it another trial of strength; and the party whose influence and interest are strongest gains the day. The bill has passed the House of Commons, and perhaps may struggle through the House of Lords after the same fashion.

This is a faint but general outline of the parliamentary proceedings upon Private Bills, and the various details which sustain this outline have the same character and stamp. In these proceedings, where is the consideration of the public good, which formed the allegation of the petition, and formed the groundwork for future legislation upon it? The public good, from the time that it was mentioned in the petition for the bill, and the occasional reference which may have been made to it by learned counsel, or honourable members in their speeches before the committee, and in the House, when at a loss for a better argument, has been quite forgotten. The petition was in effect a matter of form, a necessary preliminary proceeding; all the subsequent proceedings upon the bill have been conducted with no regard to the public good, which was at first so pompously set forth; and if any public good has been thus attained it has been effected solely because it was dependent upon and subject to private benefit. The parties who promoted

the bill rejoice in its success as in that of any other lucrative speculation, and it is not till the *bill* has passed into a law, till it is classed as a "local and personal *act* declared public," that the proceedings upon it, from the presentation of the petition to the final enrolment of the bill amongst the body of statutes, bear the least semblance to the public and national character which really belongs to them. Such have been the proceedings upon private bills; and such might they have continued to exist, but that their improprieties are too glaring longer to escape observation.

Look at the proceedings upon railway bills. Many of the members of the House of Commons are even *shareholders* in these undertakings; many more have a direct interest at stake in them as owners of property adjoining a proposed line of railway, and are enlisted amongst its most active opposers or supporters, before any steps have been taken to provide it with legislative authority. These same members, most probably, become the active members upon the committee to which the bill for the proposed railway is committed; and while professing to act for the public good, and to exercise impartially the offices and functions of both judges and jurors, which appertain to the performance of their parliamentary duties, they are in fact judges and jurors in their own cause, and biassed in their verdict by nothing more or less than the sordid love of personal gain. We can mention the names of some who fully sustain this picture; but as our object is not to expose *the persons* who have made their public station subservient to private views, as to call attention to the system under which they have been enabled to do so, we forbear. *Non referam id quod abhorret à meis moribus.* Let them, however, bear in mind that though, owing to the imperfections of the system, their errors are thus charitably treated by the writer, they are not the less obnoxious to the finger of public scorn; and let them take warning *now*, lest similar derelictions of duty should bring down upon them the public animadversion which their moral delinquency deserves.

Not pecuniary advantage only, but many other equally unworthy considerations weigh with honourable members in conceding their influence to one side or the other, and taking upon themselves an active partizanship upon private bills, derogatory to their own character and destructive to the national interests. Would it be endured that any judges of the land should adjudicate, or a juror give a verdict, in a cause to which he was a party? And yet the public may daily witness similar perversion and mockery of justice in the committees of the House of

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Commons upon private bills. The fact is too notorious to be denied, that the impartial rectitude which should guide the decisions of the members forming these committees has long since given place to the most corrupt and venal considerations, and that their proceedings have become a scorn and a by-word with all those who possess the smallest spark of ingenuousness and candour.

The principle of legislation should always be the same, viz. the diffusion of the greatest amount of happiness, or in shorter terms, the public good. The class of bills to which we have but just directed our remarks are proposed to be passed solely with that view. Such we have seen in the allegation of the petition, and we have also seen that in the whole stage of the proceedings, from the presentation of the petition to the final passing of the bill, the public good has only been subject to private interest, and the course of conduct which the selfish principle dictates, alone observed. It will naturally be asked, why has this departure from the great principle of legislation in this branch of parliamentary law taken place? and in examining this question, the defects of the present system and the remedies to be applied will naturally come under consideration.

Although a great alteration has taken place in the nature and character of private bills, and the several matters upon which they legislate requiring and calling into action the discharge of different functions and duties in the members of the legislature, yet the system of legislation has remained the same. To a certain extent the system has been affected by the orders and resolutions which the House of Commons has framed and passed, from time to time, for the observance of the parties who apply for private bills; but the system in its leading features remains unaltered. It might be curious enough to examine the occasions and times at which many of these orders were passed. Their internal evidence affords sufficient proof that they were framed to prevent the interests of individuals being compromised without due notice, and to give to those whose interests might be so affected sufficient time and opportunity to represent their grievance, and submit the protection of their interests to the special care and consideration of the House. Not a small portion too of their orders seems to have been framed to secure the efficiency of measures which might obtain legislative sanction, and to prevent acts of the legislature being passed without sufficient guarantee for the accomplishment of the objects to effect which legislative aid has been required. The general tenor and

scope of these orders seem to be, to prevent the acts of the legislature becoming instruments of injustice and oppression in the hands of those to whom their powers are confided; or from being made available to the advancement of private benefit and emolument, instead of the diffusion of general good. Our legislators are but men, and subject to the same influences as their fellows. If it has been necessary, by means of the standing orders, to curb the encroachments which interested parties might otherwise be enabled to make, by means of legislative enactments obtained under the colour of public benefit, upon the rights of others, it has been a great omission to allow the members of the legislature the uncontrolled exercise of their functions upon them. The conduct of the members sufficiently shows that their interest and duty are frequently at variance, and experience teaches us that when these two principles come into collision the latter too often yields. In the various schemes and undertakings which require the aid of legislative authority, members of the legislature in common with any other individuals obtain a great personal interest in promoting or thwarting them, and their power to do so is unrestrained by any other shackles than those of moral propriety and fitness, or such as their duty dictates. This power is chiefly manifested in the proceedings in committee, upon which we have before dwelt. At that period we find that members are exercising judicial as well as legislative functions, and upon subjects of great national interest and importance. But with the character of judges and legislators, we find that they also unite the character of partizans and advocates, and no dependence consequently can be placed in the truth and justice of their verdict and judgement.

No system, perhaps, can be devised in which interest and duty will coalesce; but a system may be devised in which the former shall not exercise a baneful influence. It seems that the pricipal defect in the present system of legislation upon private bills is in the abuse of the uncontrolled powers which are now exercised over them by members in committee. Two remedies, therefore, are open—to remove the power, or to place such a check upon it as shall ensure its application in a right direction. Whether the union of the judicial and legislative functions in the members of the House of Commons in private bills in any degree is wise and expedient, is a subject well worthy of consideration; but it appears that as at present exercised they are incompatible, and might be separated most advantageously for the public interest. Trusting that this subject may be taken up by abler hands, we cannot arrogate

to ourselves sufficient ability, even if we had the time and inclination, to propound another system for the due legislation upon the private branch of our statute laws further than the hints which have been already given. The subject, too, has already obtained the attention of the House of Commons, and we are loth to anticipate its labour. The attention of the House, it is true, was confined to a portion only of its private business, but the causes which induced that notice, in the formation of the committee to which we have before adverted, operate upon the whole. The reference to that committee, and the resolutions founded upon it, were directed "to the best means to induce members of the committees upon private bills to give unremitting attention to them,—to exercise an impartial judgement upon their merits, and to offer to the House itself the best means of forming its opinion, and deciding upon each case." We cannot desire a further confirmation of the views we have taken than is here given. But the practice which has so long obtained defies alteration from "the means" which have been suggested and the members of committees are as inattentive and partial as ever, according as their own personal interest or convenience dictates.

Let us hope, however, that before this session has elapsed some plan will be devised by the legislature to secure the more fitting discharge of the duties of its members, and one which in matters that are of great public interest will secure the advancement of public and national benefit. Under the present system great practical improvements might be made in the proceedings upon private bills, as the resolutions to which I have just adverted will testify; but it is to little purpose that orders are made and resolutions passed, if honourable members will not act in conformity with their spirit and intent, and orders and resolutions are but weak fetters upon those who have both the power and inclination to break them. So long, therefore, as the parliamentary proceedings upon private bills are conducted on their present system, they cannot be viewed with too much suspicion and distrust. In the absence of all other check and control, both the public at large and the individuals whose interests are so deeply involved in these proceedings, should watch them with a jealous eye. We shall feel satisfied if public attention should be directed to this subject, and if these remarks should be in any degree instrumental in effecting this object we shall be amply rewarded. There is but little doubt, that should this object be effected, the organs of public feeling and opinion will exercise a more salutary and efficient check and control over the

parliamentary proceedings upon private bills, and the conduct of individual members in regard to them, than any rules or resolutions which, under the existing system, the House of Commons can possibly frame for its guidance.

W. C. F.

[We regret, and we are sure our readers will too, that our able Correspondent has stopped short, and has not given us the remedy which it is evident he has in view on this momentous subject. He could not confer a greater benefit on the country than to suggest some effectual plan for securing just and impartial decisions on our railway bills and projects. From the flattering and honourable notices the 'Times,' 'Morning Herald,' &c. lately took of the Editor's sketch of a plan to secure the best working line, he may perceive how sensitively alive the most respectable portions of the public press and country are to every thing connected with this subject, which we trust will be a stimulus for him to proceed, and not to leave the work he has so well begun half finished. —Ed.]

ON THE CONVERSION OF IRON INTO STEEL.

By William Maugham, Esq.

To the Editor of the Railway Magazine.

Dear Sir,

Of all metals iron is undoubtedly the most useful to man, yet its properties, comparatively speaking, are but little understood; and the compound called *steel*, which appears to consist of iron in union with carbon, has puzzled every chemist whose attention has been directed to it. Do iron and carbon combine in all proportions, like water and sulphuric acid, &c., or do they only unite in definite proportions? for this has not yet been determined. In whichever way the combination takes place, still the mere union of the elements in question only produces a compound that is not subservient to the purposes of steel until it has undergone the process of *tempering*. Well, and what is tempering? The mode of manipulation almost every one understands; but how does it happen that the subjecting a compound of iron and carbon to certain degrees of temperature should impart to it certain habitudes which it did not previously possess, although, as far as we know, the quantities of iron and carbon constituting

the tempered steel still remain the same? It may be answered, that the particles of steel during the process of tempering are brought within a certain sphere of attraction, according to the temperature employed, which arrangement of the particles communicates to the steel its requisite hardness and elasticity. This answer is by no means satisfactory, but in the present state of chemical science it is perhaps the best that can be given. That the texture of steel is influenced by the heating and cooling processes during the tempering, may be strikingly illustrated by repeating the following experiment:—A short time ago, I fused some cast-iron nails on a charcoal support by means of the blow-pipe, which I recently brought before the public in a paper published in the *Transactions of the Society of Arts*. On pouring the fused mass into water, I observed that there was no hissing as when red hot iron is put into that liquid; that the water was not decomposed; and, consequently, that the iron or steel was not oxidized on the surface, but appeared perfectly bright. My friend Mr. Hemming proposed to vary the experiment in the following manner:—A piece of glass was placed at the bottom of the tank which is in the long room at the Adelaide Gallery; the metal, fused as before, was then poured into the water, through which it had to pass fourteen inches in depth before reaching the glass. At this depth it remained for several seconds in a candescent state, burning a hole through the glass, and then taking the impression of the flat surface of a piece of tin, placed underneath the glass to receive it. The steel thus produced is so hard that it will cut glass as readily as a diamond, and bears a very high polish. From these experiments I think we may deduce the following facts, viz. that iron does not decompose water at its fusing point; that steel thus cast into water is rendered considerably harder than that obtained by the usual method; and lastly, that if attention be paid to the subject, very superior and useful ornamental castings may be obtained, the mould for receiving the fluid metal being of course placed under water at a requisite depth, which experience will point out. Having repeated these experiments before several scientific gentlemen who were not previously aware of the results, I have ventured to forward these hasty remarks to you, that you may lay them before the public should you deem them worthy of notice.

I am, dear Sir, yours truly,

WILLIAM MAUGHAM.

Adelaide Gallery,
June 23, 1836.

KENT AND ESSEX AND DARTFORD AND CRAYFORD RAILWAY AND NAVIGATION.

To the Editor of the Railway Magazine.

SIR,

UNDER this title a prospectus has been issued, embracing the establishment of a direct line of railway communication between Kent and Essex, and the improvement of the navigation between the Thames and Dartford and Crayford.

A better mode of communication between Kent and Essex has long been required; and if a junction be effected between the lines of railway traversing these counties, the whole of the eastern counties and the entire county of Kent will at once be brought into close intercourse with each other, which to the county of Kent must prove of incalculable advantage.

The latter part of the plan seems to proceed upon the acknowledged principle that a good water communication to a railway terminus benefits the railway itself, each promoting and encouraging that description of traffic upon the other to which each is more particularly applicable. Contrasted with the scheme for making a ship canal to Dartford, to which I incidentally drew your attention in your first Number, and which has since failed by the withdrawal of the Bill which was introduced for it, after three days' struggle for existence in Committee, this part of the plan has many features to recommend it; and if the undertaking be properly conducted it bids fair for a successful issue.

23rd June, 1836. VIATOR.

[We wish our correspondent had gone more into the detail of this scheme. As it is we can only see something of a plan embracing in all probability considerable advantages, without a sufficient detail of its advantages to enable us to decide on its merits.—EDIT.]

SCIENTIFIC AND MISCELLANEOUS INTELLIGENCE.

Two Mermaids caught in the river Gabon, Africa, and seen by Captains Alfred Herapath and H. Pearce, and Mr. Dyer.—The following description of the mermaid, by the eldest son of the Editor of this Magazine, Commander of the brig *Tom Cod*, in the employ of Messrs. King of Bristol, will we hope set at rest a most important question in natural history. We only regret that the description is not more minute, and that he had not brought the smaller fish home. Some excuse, however, may be made for a young man just raised to so important a trust as that of commander, having a valuable cargo, and the anxiety naturally attendant thereon. That the most perfect reliance may be placed on the statement we are quite certain, both from his known veracity and from the examination we ourselves have given him.

It seems this is not the first fish of the kind taken in the river Gabon. The natives had informed Capt. Herapath of such things in a former voyage, and his treating the information lightly was their reason now of sending for him to see it. They say it is by no means a common occurrence, and that great art is used in catching the mermaids, which are very shy. Of the habits of the fish such ignorant people of course knew nothing. They talk of a cry it utters; but what sort of a one could not be learned so as to place any dependence on it. Like beasts of prey, the moment anything eatable is taken it is devoured, which is the reason of the larger fish having been cut up when our son arrived.

He has not spoken of the tail; but from what I learnt in conversation with him, it appears that the fan of the tail is one undivided fin, and the plane of it, when the fish is swimming, horizontal, not vertical like that of other fish.

"Gabon, 16th August 1835, P.M.—I received intelligence that a native residing at Sam's Town had taken a singularly shaped fish, which, from the description given, I imagined to be a mermaid. On reaching the hut, I found two, both females; the largest was cut up; the natives in the act of preparing it for a meal. Of the other, the following is a brief description. Length about 5 feet; breadth across the shoulders about 14 inches; the head something like that of a porpoise, and without hair, united with the body by a short neck. From the shoulders downwards the shape was exactly the same as represented in the engravings of the mermaid, with the exception of the arms. Instead of hands, they terminate the same as a turtle's fin, and have no joints except at the shoulders. The breasts were perfectly feminine, and the arms folded across as if to protect them. The skin was thick, of a dun colour, and surface of it quite smooth.

"The natives inform me that this animal when seen always appears erect, with the head and shoulders above water, and the arms in the same position as when I saw them.

"From the circumstance of the two being taken together, the

smallest encircled in the arms of the largest, I conclude it must have been a mother and her offspring. I ate a small portion of the large one dressed; the flesh resembled that of a pig both in colour and flavour. The lean part was particularly pleasant to the palate, and the fat was at least two inches thick, and rather disagreeable, being strong.

"The Captain, Mr. H. Pearce, and Chief-mate, Mr. Thomas Dyer, of the *Pitt* of Bristol, accompanied me ashore to see them. The former is since dead, but the latter is now commander of the *Pitt*, and would, I have no doubt, on his return to England, confirm the account I have given.—Brig *Tom Cod*, A. N. Herapath, Commander."

Statistical Facts.—The following facts are from a French work, and appear to have been made with great research.

For every marriage there are in

Savoy	5·65	Births	Part of Scotland....	5·13	Births
Gov. of Venice......	5·45	—	Moravia and Silesia	4·81	—
Bohemia.............	5·27	—	Low Countries......	4·56	—
Muscovy............	5·25	—	France...............	4·21	—
Province of Bergam	5·24	—	Sweden..............	3·62	—
Portugal.	5·14	—	England.............	3·50	—

By this table it would appear that England, instead, as commonly asserted, of being more prolific than most other countries, is less so than the eleven preceding, there being only 7 births to 2 marriages, while in France there are nearly 8½, and in Savoy 11⅓. But according to Mr. Corbaux, one of the most scientific writers in this country on the subject, the number of children to each marriage, at least in France, has been regularly decreasing for many years.

The former author says that the births of boys exceed those of girls in the Low Countries, in the ratio of 10,000 to 9480 in cities and towns, but in the ratio of 10,000 to 9375 in country places. Thus there are for the same number of boys more girls born in cities than in country places. Query, is not this owing to the greater relative dissipation of the men, and consequent enervation, in cities than in country places? The same argument applied to the above table would make it appear that England is the most dissipated of all the twelve countries cited.

By 13,000,000 observations on different parts of the globe, M. Villermé has found that different months have different effects, not only on the number of deaths, but correspondingly on that of the births. Eighteen years' observation at Brussels give the following proportional numbers for the various months.

	Deaths.	Births.		Deaths.	Births.
January	1172	1040	July	806	901
February	1110	1157	August	844	903
March	1100	1099	September	884	940
April	1068	1079	October	954	949
May	995	989	November	975	968
June	916	956	December	1175	1172

There are more births and deaths therefore in December than in any other month of the year, and less in July.

Mr. Corbaux above referred to, who has examined every part of the subject connected with the laws of mortality with singular care and success, in his published works, says that in France the average number of births to a marriage has been gradually decreasing from 1817 when it was 4·29524 births to 1 marriage, to 1830 when it was only 3·32277 births to 1 marriage. A similar decrease he also finds has taken place in the proportion of male births to female. In illegitimate births the proportion of the sexes approaches nearer to an equality and is less variable.—*Corbaux on Population.*

Alarms for the Timid.—M. Arago, the French writer, has lately published a curious collection of observations relative to what are commonly called shooting-stars, and drawn an inference from them which, when considered *in consequentia* is enough to frighten half the old women into the commission of suicide to avoid being mangled and murdered.

He supposes that the falling or shooting stars are independent bodies moving round the sun, as our earth and the other planets do, and which come occasionally so near to us as to pass through our atmosphere, at which times they inflame and become visible. The number of them he supposes to be prodigiously great, forming a sort of zone, which cuts the earth's path at the point in which it is about the 12th or 13th of November. Now if these bodies come so very close to us as to penetrate our atmosphere, which we have great reason to believe does not exceed one- or two-and-thirty miles high, and in such immense numbers that they appear half as numerous as the flakes of snow in a snow-storm, which has been the case in America it seems, what reason is there why they should not strike or graze the earth and sweep us off by wholesale? If M. Arago be right, we shall perhaps before long hear some one assert on his authority that these bodies are the grape and canister shot of a heavenly artillery, contrived by the Deity for the purpose of disappointing the apprehensions of Malthus and others, who fear we are becoming too numerous to subsist.

We have somewhere read that the Welsh think the shooting-stars a set of fiends in the shape of dogs inhabiting the air, and that the trailing lights are the scuffles made by them in pursuing souls separated from the bodies of persons just then dead, in order to take them to the lower regions! What a difference between the wild flights of superstition and the fanciful excursions of philosophy! The one appears like the pleasant fictions of Scott, the other like the terrible monstrosities of Southey's old woman of Berkeley.

The phenomena on which M. Arago founds his hypothesis are the following. In the night of November 12th and 13th, 1833, so many shooting-stars were seen at Boston, America, for seven hours together, that they appeared at one time about half as thick as the flakes of snow in an ordinary snow-storm, and the number during seven hours was computed at 240,000. A like shower of falling stars

was seen by Humboldt in America, the Moraves in Greenland, and several persons in Germany, on the night of the 11th and 12th November, 1799. Again, the same phenomenon occurred on the Spanish coast, near Carthagena, in the night of November 12th and 13th, 1831; and in Arabia, in the night of November 12th and 13th, 1832. Lastly, Messier is reported to have seen, for five minutes together, on the 17th of June, 1777, about noon, a "prodigious number of black globes" pass across the apparent surface of the sun.

M. Arago likewise adds, that the ordinary course of these bodies is directly opposite to that of the earth in its orbit; which we confess, from the few observations we have heretofore made, appears to us somewhat extraordinary. If our recollection is right, we think we have seen two, three, or more of them, in the same night and within a few minutes of each other, take very different directions. He also says that their apparent velocity is about 36 French leagues per second, or double that of the earth, and that certain of them have been computed to be 500 miles high.

Now, in answer to M. Arago's hypothesis, we say that there is the greatest reason to believe the atmosphere does not extend much above 30 miles high, and therefore 500 miles high must be vastly beyond its limits. It is also certain that a body 500 miles high would be attracted nearly 70 times greater by the earth than by the sun, which would so derange its orbit as to render it next to a miracle it should continue to follow the same course, and appear at the same time in the same place year after year. We believe we may say it would be impossible; and therefore some other explanation must be sought.

New Moving Power.—A letter from Frankfort says: A discovery of immense importance has been communicated to our Society for the Promotion of the Physical Sciences. The discovery is that of an impulsive force more powerful than that of gunpowder or steam. Our men of science are in raptures, and are preparing their reports, which will be very shortly published. All that we yet know is that the moving power is a galvanic machine, the action of which it is said will equal that of steam, without the expense and without the danger.—*Greenwich Gazette.*

Fisher's Views in Syria, the Holy Land, Asia Minor, &c. &c.—Though we shall never perhaps carry railroads into the Holy Land, yet the mighty events which have occurred there, and the close connexion it has with our religion, render everything connected with it of deep and untiring interest. We are glad therefore to see a work of the above title undertaken. It comes out in monthly parts, each containing four engravings of the most remarkable places, illustrated with very interesting descriptions of them by John Carne, Esq. We have seen the two first Numbers, the plates of which are executed in a masterly manner, and would almost themselves tell the tales Mr. Carne relates with so much vividity and enthusiasm.

RAILWAY NOTICES AND INTELLIGENCE.

PROGRESS OF RAILWAY WORKS.

Birmingham Railway.—The works of this line are proceeding with great activity. Upwards of 10,000 men are daily employed on the works, exclusive of brickmakers, quarrymen, &c. The tunnels at Primrose Hill and Watford are very nearly completed.

The Great Western Railway.—The works for the Great Western Railway are now commenced in several parts of the proposed line. Upwards of 100 workmen have just commenced their labours in the neighbourhood of Corsham, and near the village of Box, Wilts; their wages are from 14*s*. to 20*s*. a week, an advance in the amount of wages within a very short period of at least *one third*!—*Morning Herald.*

The Preston and Wyre Railway and Harbour.—This undertaking, under its present active and judicious directory, appears to be pursuing its course steadily to completion, little affected by the excitement or depression of the share-market; and such a result naturally arises from the limited number of its shares, and consequently leaving little for such speculation: yet, although unostentatious in its course, there is not any undertaking presenting more splendid prospects.

The railway, passing over nearly level ground, at an expense of not more than one fourth of any similar distance, connects a large and rising manufacturing town, and an extensive manufacturing district, with a safe and ample harbour, which, for want altogether of any communication with it, has until lately lain neglected.

The harbour is so situated that, although only about 30 miles north of Liverpool, vessels, when altogether windbound there, will *here*, at all times, readily get to sea.

This important advantage, with as ready an access to the Manchester, and the manufacturing towns as Liverpool, and with a saving of nine tenths of the Liverpool dues, must in time make it a formidable rival to Liverpool itself. The proposed Trading Company will also altogether obviate the want of resident agents until the commerce there shall have greatly increased.

We need hardly call attention to its locality, as presenting the readiest means of communication between Ireland, Isle of Man, &c., and this country.

The spirited promoter of this undertaking, Mr. Hesketh Fleetwood, one of the members for Preston, has, we understand, already had the plans drawn and ground laid out by Mr. Decimus Burton for a new watering-place near the Wyre terminus, the buildings of which are to be in the style of Brighton and other fashionable places of resort on our southern coast; and the district which is set apart

for New Liverpool is marking out for streets, and building is already commenced there.

From the very small capital required for this undertaking, heavy goods, which on other railways are generally unproductive, will here afford large profits; and besides the dues on the railway, this Company will have the additional and unusual ones of those to be taken from all vessels entering the harbour or using their wharfs.

We must say that we look with much interest at this undertaking, affording as it does the near prospect of an ample and safe harbour on a coast which is proverbially dangerous, and an immense saving of dues and expense to the extensive shipping and mercantile interests of Lancashire.

London and Southampton Railway.—The works on this railway are proceeding with considerable activity. Between 2000 and 3000 men are engaged in their execution.

Notwithstanding the extraordinary facility for approaching London in the direction which this line takes, owing to the comparatively small number of residence properties which are interfered with, still the promoters of the undertaking, in order to avoid that interference, found it expedient to encounter some heavy works in excavations and embankments. An instance of this sort occurred in passing Oatlands Park, the residence of His late Royal Highness the Duke of York, where a cutting of upwards of 100 feet deep, through what has been called St. George's Hill, was submitted to, rather than endanger the success of the Bill in Parliament. Subsequent negotiations, however, have produced an arrangement by which a nearer approach to the residence is permitted, and the cutting is reduced to about one fourth of its originally proposed quantity. A similar mode of proceeding between the Directors and the landed proprietors will, it is expected, authorize a deviation by which the tunnel at Popham will be avoided; so that passengers by this railway may travel from one end to the other without being subjected to the inconvenient but sometimes unavoidable annoyance of a subterraneous passage. Where the object of the traveller is pleasure, as is or will be the case on railroads to such places as Southampton, Brighton, &c., &c., this is very important. With the exception of that part of the line where this tunnel was to have been, every point at which workmen can be placed is in progress; many bridges are already completed, and those for passing the valleys of the Wandle, the Mole, and the Wey, will be forthwith commenced.

RAILWAY NOTICES.

The Boston and Nottingham line of Railroad.—The distance by this line will be within 47 miles, which will be performed within two hours and a half. The line will pass up the Forty-foot drain, from Boston to Heckington, Sleaford, from thence to Broadwater, Ancaster, Willoughby Marston, Foster, Staunton, Flawboro', Scarrington,

Bingham, Radcliffe, to the East-croft meadow at Nottingham. A branch line will be established to Grantham and Newark.

The Brandling Junction Railway.—The Brandling Junction Railway Bill has received the royal assent. The works will be commenced forthwith, and it is anticipated that the whole line connecting Gateshead, South Shields, and Monkwearmouth will be completed in two years.

Calcutta and Saugur Railway.—The superintendent, accompanied by proper assistants, has lately proceeded to India to commence the construction of this line, and the most vigorous measures are in progress to carry out and complete the works. The facility of obtaining labour in that country renders it extremely probable that the whole will be finished and making returns to the shareholders within a comparatively short period.

Carlisle and Maryport Railway.—The shares of this railway are filling up rapidly; about 2000 have been already taken, amounting to 100,000*l.*, half the capital required. Mr. Stephenson has agreed to make a survey of the Caledonian Railway from Lancaster to Maryport, where it will adopt the Maryport line to Carlisle with a view to its continuation to Glasgow.

South-Eastern Dover Railway, and Kent Railway.—The unopposed progress of the South-Eastern Railway Bill through the Lords was the result, we learn, of an understanding with the Kent Railway Company. The latter will now, it is believed, be permitted to carry a line unimpeded through the populous towns of Dartford, Gravesend, Strood, Rochester, Chatham, Faversham, and Canterbury, to Ramsgate, with branches to Maidstone, Sheerness, Sandwich, and Deal. The South-Eastern, on the other hand, will enjoy their traffic uninterruptedly through the Weald of Kent to Dover, and thus each part of the county will have its line without exposing the Companies to vexatious opposition, and its necessary consequence, an immense expenditure of money. The arrangement now come to is precisely what the Editor of this work earnestly urged and recommended to both Companies in the beginning of the contest in the Commons.

The Deptford Pier Junction Railway Bill has passed the Lords, by which a quick communication in fifteen minutes by the railway would be secured from London Bridge to the steam-vessels at Deptford, and the pool and its dangers and delays avoided.

Gloucester and Birmingham Railway.—The most active preparations are being made for commencing and carrying on the work of this line.

Gloucester and South Wales Railway.—Mr. J. K. Brunel is proceeding with his survey of the lines for a railway radiating from Gloucester through South Wales. The new line will carry a communication directly through North Wales to New Quay, in the Cardigan Bay, and thus afford a direct communication with Ireland.

Holyhead and London Railway.—It is said that instructions have been given to the engineers, Messrs. Vignolles and Nastrick, to survey the country from Holyhead through Wales to Chester, for the purpose of forming a railway to the one from Chester to Crewe. On the other hand, a line has been recommended from Wolverhampton to Newport, to near Wem and to Chirk; thus avoiding Oswestry, Shrewsbury, and the mineral districts in Shropshire.

Merthyr and Cardiff Railway.—There is a drag affixed to the Merthyr and Cardiff Railway, which, unless it can be explained satisfactorily, will continue to excite, as it has already excited, the surprise and disappointment of all who feel an interest in railway transit. We mean the clause which limits the maximum of—we will not call it *speed*, but a snail's gallop—to *twelve* miles an hour. This is tying up the legs of a giant with a vengeance, and what "should be great" is seemingly "turned to farce." Why, in a few years a broad-wheeled fly-wagon will attain this Parliament speed. Twelve miles an hour! the thing is a contradiction in terms! the provision would hardly be exceeded in absurdity if it had directed that the locomotive engine should move crab-fashion. We really consider the bill more than half-neutralized by this clause, and we are sure that the proprietors will never be satisfied until this obnoxious provision has been repealed, and that the full advantages of railroads shall be secured to them. An outlay of hundreds of thousands of pounds to be permitted to travel twelve miles an hour by steam!—Preposterous!—*Chester Courant.*

Newcastle and Carlisle Railway.—On Saturday the 11th of June the Newcastle and Carlisle Railway Company opened that portion of their line extending from Blaydon to the Eastern Bank of the river Derwent. They are rapidly progressing towards Newcastle, and every step in that direction must be of great importance, not only to the Company but to the public. It is said to be quite certain that seven miles in extent, namely, from Hexham to Haydon Bridge, will be opened on the 28th instant, and that a further portion of twenty miles is now in readiness, and only waits the completion of the Depôt at Carlisle, which will be effected so as to open this extensive portion on the 19th of July.

Railroads.—In addition to Mr. Walker's line from London to York between Huntingdon and St. Ives, there is to be a line from Lynn to Earith, at the foot of the Hundred-foot, and thence to the banks of the Ouse to St. Ives, Huntingdon, and St. Neots, where it will join the line from Cambridge to Bedford, and communicating with Birmingham, Oxford, and the West of England. The plan has been laid before, and it is said received the approbation of, the Board of the Bedford Level.

South Durham Railway.—The preamble and all the clauses of the South Durham Railway Bill have been proved in a committee of the House of Commons by a majority of eleven to eight. Mr. Pease was present but did not vote. The bill will now probably pass

the Commons, but it is understood it will be exposed to a formidable opposition in the House of Lords.—*Newcastle Journal.*

South London Union Railway.—A company is formed under the above title, which has for its object the construction of a viaduct to join the London and Southampton Railway at Vauxhall, and afford to the passengers arriving from all parts of the South and South-West of England a continuous railroad to the immediate vicinity of Blackfriars Bridge. We understand that the Directors and Proprietary of the London and Southampton Railway will support the South London Union Railway, and furnish a considerable portion of the required capital.

The South Durham Railway.—Coal Monopoly.—The South Durham Railway remained victorious in four successive contested divisions on the clauses in Committee, all having the same tendency, viz. to burden the new coal which this railway will introduce, with a heavy import, in order to counteract the decided advantages the South Durham coal district possesses over the old ones of the Tyne and Wear, conducted on the *way-leave* system. The public most unquestionably will derive much benefit from the importation of this new and excellent coal, which must supersede a vast quantity of very inferior fuel now forced upon the public through the medium of the existing monopoly, and a higher price than the South Durham coal can be supplied at. This railway had stood a very severe opposition from the large and wealthy coal-owners of the North.

Railways to Sheffield.—Proposals have been made which may end in the withdrawal of the opposition of the town of Sheffield to Mr. Stephenson's line of the North Midland Railway. The conditions required of that Company are believed to be, that it shall cease its opposition to the continuation of the Midland Counties Railway as a travelling line to Pinxton; and shall also undertake not to oppose any line of railway which may be projected, for continuing the line from Pinxton to the terminus of the proposed Sheffield, Ashton-under-Lyne, and Manchester Railways at Sheffield.

Sheffield and Manchester Railway.—Active measures are taking for the survey of a line between these places.

Whitby and Pickering Railway was opened May 26th. The scenery of the whole line of road is romantic, wild, and picturesque beyond description, and the six miles beyond Newton Dale to Pickering equals, if not surpasses, the far-famed country of Studley Park, the line of the North.

FOREIGN RAILROADS.

Brussels Railroad. Antwerp, 24th May.—" Yesterday the last train of carriages that left Brussels by the iron railroad consisted of

35 carriages drawn by two steam-carriages; there were at least 1000 passengers. This immense train performed the journey in less than one hour and a half.

"It is estimated on a calculation which cannot be far from the truth, that the number of persons who left Brussels by the iron rail-road on Sunday and Monday (the 22nd and 23rd May) was 17,000. Supposing that the number who returned was equal, we have 34,000 passengers in two days. The conveyance of 17,000 passengers by the ordinary means would require above 1000 diligences; and as 15 horses at least are required for the use of one diligence between Antwerp and Brussels, we see that the steam-carriages produce in one day an effect equal to that of 15,000 horses."

Vienna, June 13th.—The apprehensions that have for some time been expressed with respect to the construction of the iron railroad from Vienna to Bohemia become more and more serious. They are of such a nature that Baron von Rothschild, the real author of the undertaking, from whose coffers the not inconsiderable preliminary expenses have been defrayed, seems gradually to give up the hope of success, perhaps in consequence of a more accurate investigation. Many persons, however, think there is a middle course between the expensive mode of construction hitherto adopted and a total abandonment of the undertaking? The public having conceived great hopes of the result of this work, would be rendered indisposed to future undertakings if this should be wholly given up.

Railroads to the Rhine.—According to the *Journal d'Anvers*, the King of Prussia has indefinitely deferred his consent to the railroad from Antwerp to Cologne. It appears therefore that our informant was right in presuming the reluctance of the Prussian Court to promote that measure.

A late number of the *Courrier Belge* stated, that upon the occasion of the opening of the iron railroad between Antwerp and Brussels, the Dutch police issued a notice to the inhabitants of the frontiers, threatening them with a fine of 10 florins each if they ventured to go and witness the ceremony.

Railroads in Italy.—The execution of a plan for an iron railroad between Vienna and Trieste, will be commenced by the construction of such a road between Trieste and Milan, the detailed plan of which is already under the consideration of the Imperial Government. Meanwhile the shares of the iron railroad which has already commenced between this city and Bochnia have fallen in price, but they are still from six to eight per cent. above par. The only reason that can be assigned for this is the favourable accounts that have latterly appeared in some journals respecting the profits of iron railroads in other countries.

PARLIAMENTARY PROCEEDINGS ON RAILWAYS.

HOUSE OF COMMONS.

May 30th. On the motion of Sir M. S. Stewart, time given for the Glasgow and Falkirk Junction Report until the 20th June.—May 31st. Reports on the London and Cambridge: Merthyr Tidvil and Cardiff; London and Norwich (Eastern Counties); the Tremoutha Harbour and Railway Bill; and on the Thames Haven Railway and Dock Bill, brought up.—June 1st. The Midland Counties, the Deptford Pier Junction, the London and Dover (South-Eastern), and the Merthyr Tidvil and Cardiff Bills, were read a third time and passed; the South Durham Bill's Report extended to the 17th instant; the Committee on the Glasgow and Falkirk Bill to report on or before the 20th inst.; the Dublin and Drogheda Railroad Bills Report extended to the 20th inst.—June 7th. The Reports on the following bills taken into further consideration, the resolutions agreed to, and ordered to be engrossed, viz. the London and Croydon, the Thames Haven Railway and Dock Bill, and the Preston and Longridge Bill.—June 9th. The Thames Haven Railway and Dock Bill read a third time, and passed; the Report on the South Durham Bill brought up.—June 10th. The London and Croydon Railway Bill read a third time, and passed.—June 13th. Petition from Brunswick-square, Brighton, complaining of the injury which would be done to their property by the proposed lines of Railway, referred to the Brighton Committee.—June 14th. The Preston and Longridge Bill read a third time, and passed; the Report of the Manchester and Cheshire Junction Bill agreed to. Upon the motion of Sir William Molesworth, the Falmouth Railway and Harbour Bill passed through another stage, after a discussion, and division of 124 to 51 in its favour.—June 16th. The Dublin and Drogheda Bill reported; the Manchester and Cheshire Junction read a third time, and passed.—June 17th. The reports of the London and Brighton (Stephenson's line) and the London and Blackwall Commercial brought up.—June 20th. The South Durham reported.—June 22nd. Committee on the South-West Durham Bill ordered to reassemble, and report why they had decided against the preamble's being proved.

HOUSE OF LORDS.

May 30th. Several Petitions in favour of the North Midland; from the Commons brought up the Edinburgh, Leith, and Newhaven Railway Bill, read a first time.—June 2nd. The Midland Counties, the London and Norwich (Eastern Counties), the London and Dover (South-Eastern Counties), the Deptford, and the Merthyr Tidvil and Cardiff were brought up from the Commons, and read a first time.—June 3rd. The London and Cambridge brought up from the Commons.—June 4th. Marquis of Clanricarde moved the third reading of one of the almost innumerable Railway Bills now before Parliament. The Duke of Wellington suggested the suspension of further proceedings in this and other Railway Bills, in order to give time for

devising some measure for protecting both the public and the proprietors against future mischief, by empowering the legislature to revise this species of statute after a certain time. Lord Clanricarde agreed to suspend his bill (the Birmingham, Bristol, and Thames Junction).—June 6th. A great number of Petitions in favour of the North Midland Bill; Petitions in favour of the London and Dover (South-Eastern) Bill; which was read a second time, and witnesses to be examined in support were sworn.—June 9th. The Deptford Pier Junction Railway Bill, and the Edinburgh, Leith, and Newhaven Railway Bill, read a second time; several Petitions in favour of the Great Northern Bill; Petitions in favour of the North Midland Bill.—June 10th. The London and Croydon brought up from the Commons; a Petition from the Trustees of a Chapel at Croydon against a part of the South-Eastern Railway.—June 16. The Duke of Wellington moved, on the third reading of the London Grand Junction Railway Bill, that there be inserted the following clause: "Provided always, and be it further enacted, that nothing herein "contained shall extend or be construed, deemed, or taken to extend, to exempt the railroad to be formed under or by virtue of the "powers in and by this act contained and given, or any branch thereof, "from the provisions of any general acts for the regulation of rail-"roads which may be passed with a view to the advantage, protec-"tion, and security of the public, before the expiration of one year "from the passing of this Act, if Parliament shall be sitting at the "expiration of such period of one year, or (if Parliament shall not "then be sitting) before the end of the then next session of Parlia-"ment." The Noble Duke stated his intention to move the insertion of the clause in all future bills that came before their lordships. After a long discussion, the house divided; when there appeared, Content 33, Not-content 15; majority in favour of the clause 18: the clause was then added, the bill read a third time, and passed. The Earl of Radnor moved the third reading of the London and Dover (South-Eastern): read a third time and passed.—June 20th. The Manchester and Leeds read a third time and passed; the Report of the Committee on the Leeds and Derby presented. On the motion of the Duke of Richmond, the following lords were added to the Locomotive Engine Committee: the Marquis of Salisbury, the Marquis of Londonderry, the Earl of Dartmouth, and the Earl of Oxford.—June 21st. The Royal assent was given to the London and Dover, the Cheltenham and Great Western, the Midland Counties Bill; the Birmingham, Bristol, and Thames Junction Bills. The Sheffield and Rotherham read a third time, and passed. The Manchester and Leeds brought up from the Commons, with the Lords' amendments agreed to; the North Midland committed; Petition from Manchester in favour of the Cheshire Junction Railway Bill; Petitions from Stockport, Derby, and Uttoxeter against the Cheshire Junction Bill.—June 22nd. Royal assent given to London and Dover; Cheltenham and Great Western; Midland Counties; Birmingham, Bristol, and Thames Junction Bills.

PRICES OF RAILWAY SHARES.

Those finished are marked (1); in progress (2); which have their bills but are not begun (3); in Parliament (4); not in Parliament (5).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum Paid.	Closing Prices of Shares in London Markets on								
					May	June							
					31.	3.	7.	10.	14.	17.	21.	24.	28.
			£.	£.									
15,000	....	Altons and Lubeck	20	½	....	....	....	....	½	½			
2,500	....	(3) Aylesbury	20	1									
		(3) Birmingham and Derby	....	5	10	10¼	10	9½	9¾	10			
9,500	....	(3) Birmingham and Gloucester	....	5	6½	6½	8	8	8¼	8	7½	7	
7,500	....	(3) Birmingham, Bristol, and Thames Junction	20	1	1	1¼	1¼	1¼	....	....	1¼	1¼	
15,000	....	(3) Bristol and Exeter	100	2½	3½	3¼	4½	6¾	4½	4½	....	4	
660	....	Calcutta and Saugur	50	2	....	1¼	1½	....	....	1	1		
350	....	Cheltenham	100										
7,500	....	(3) Cheltenham and Great Western..	100	2½	3	3	3¾	3¼	3¾	4¼	....	4¼	
14,000	....	(5) Cheltenham, Oxford, and Tring .	100	5	....	3½	3						
2,000	....	(2) Clarence	100	100	....	....	43	43	...	40	40		
12,000	....	(4) Commercial Blackwall	50	2	2½	2¼	2¼	2¼	2⅞	2⅜	2¼	2⅜	
8,000	....	(5) Dublin and Kilkenny	100	2½	....	....	....	2½	....	2⅜	2¼		
7,500	....	(4) Durham South-West Junction ..	20	3	....	....	....	....	....	....	....	1	
37,600	....	Eastern Counties	25	1	1¼	1¼	1½	1½	1⅜	1¼	1⅜	1¼	
		Edinburgh and Dunbar	....	2									
5,000	....	(4) th, and Newhaven	20	1	....	....	....	1¼					
13,000	....	(5) Glasgow........	50	2	....	5	4¼	4¼	4¾	5	5¼		
2,500	19s.	....	50										

800	....		Durham Junction	100	10								
2,800	....	(4)	Glasgow and Falkirk Junction	50	3								
		(2)	Grand Junction	100	40								
			Great North of England	....	2	2¾	2¾	2¾	2¾	2½			
		(5)	Great Northern	100	2	....	¾	....	....	....	....	....	¾
25,000	....	(2)	Great Western	100	20	46½	47	46	46	45½	44	45	44½
2,000	....	(2)	Hartlepool	100	100	....	....	....	....	....	100	100	
2,100	....	(4)	Hull and Selby	50	5	7¼	8¼	8	7½	7¼	8	7¾	
10,000	....	(3)	Leeds and Manchester	100	5	22½	23¾	22	22½	23	23	23	23
7,000	....	(1)	Leeds and Selby	100									
2,000	....	(1)	Leicester and Swanington	50	50								
5,100	10*l.* per c.	(1)	Liverpool and Manchester	100	100								
			Ditto, ¼ shares	25	25	....	....	....	65	65	65	65	
10,000	....	(4)	London and Brighton (Stevenson's)	100	5	19½	19	17	18	18½	19	18	17
45,000	....	(5)	——— (Gibbs)	20	1	⅞	⅞	....	⅝				
16,000	....	(5)	——— (Rennie)	50	2	1⅝	1½	1½	1⅛	1⅛	1⅛	1	1⅛
8,000	....	(5)	——— (Cundy)	100	2	1½	1¼	1	1½	1¼	....	1⅛	
12,000	....		London and Blackwall	50	3	3¼	3½	3⅜	4⅝	3¾	3⅜	3⅛	3
		(5)	London and Dover	50	1	....	¾	....	....	⅝			
30,000	....	(5)	London and Gravesend	20	1	¾	¾	⅜	⅜	¾			¾
20,000	3*l.* per c.	(2)	London and Greenwich	20	20	26½	25	25½	25½	25½	25¾	25⅛	25¼
			Ditto, Bonds.		....	....	....	....	....	100½	100⅛	100⅛	
25,000	....	(2)	London and Birmingham	100	60	133½	....	133	135	134	....	....	133
20,000	....	(2)	London and Southampton	50	20	25¼	25½	26½	26	....	26	26¼	25¾
7,000	....	(3)	London and Croydon	20	5	....	4¾	....	4⅜	4¾	4½	....	4⅝
12,000	....	(3)	London Grand Junction	50	2	3	3¼	3¼	3	3¼	3½	2⅞	2¾
1,000	....	(5)	Manchester and Oldham	100	3								
10,000	....	(5)	Manchester South Union	100	2	4¼	3¾	3½	3⅝	3½		3	3½

PRICES OF RAILWAY SHARES (Continued).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum Paid.	Closing Prices of Shares in London Markets on								
					May	June							
					31.	3.	7.	10.	14.	17.	21.	24.	28.
			£.	£.									
		(3) Midland Counties	50	5	....	$6\frac{3}{4}$	....	....	....	....	$6\frac{1}{2}$		
		(5) Margate and Ramsgate	....	2									
		(3) North Midland	....	5	13	$13\frac{1}{2}$	$12\frac{1}{2}$	$12\frac{3}{4}$	$11\frac{3}{4}$	$12\frac{1}{2}$	$12\frac{1}{2}$	$11\frac{1}{2}$	
		(4) Northern and Eastern	100	3	$4\frac{1}{2}$	$4\frac{1}{2}$	$3\frac{3}{4}$	$3\frac{3}{4}$	4	$3\frac{7}{8}$	$3\frac{1}{2}$	$3\frac{1}{2}$	
2,500	....	(2) Preston and Wigan...........	....	20									
2,600	....	(2) Preston and Wyre	50	3									
4,000	....	(3) Sheffield and Rotherham	25	$3\frac{1}{2}$	....	....	....	....	....	....	....	$4\frac{3}{4}$	
1,000	6l. per c.	(1) Stockton and Darlington	100										
1,500	....	(2) Stanhope and Tyne	100	100	105	105	105	105	105	105	105	105	
3,000	....	(4) South Durham	50	$2\frac{1}{2}$	....	$2\frac{3}{4}$	....	$2\frac{1}{2}$	$3\frac{1}{2}$	3			
28,000	....	(8) South-Eastern	....	2	5	$6\frac{1}{2}$	$4\frac{1}{2}$	$5\frac{1}{2}$	$4\frac{1}{2}$	5	$5\frac{3}{4}$	5	
		(5) South Midland	50	1	....	1	$\frac{7}{8}$	....	$\frac{7}{8}$	....	$\frac{7}{8}$		
40,000	....	(5) South-Western	50	1	....	$\frac{7}{8}$	....	....	$\frac{7}{8}$	$\frac{3}{4}$			
9,000	....	(4) Thames Haven	50	$2\frac{1}{2}$	$2\frac{3}{4}$	$2\frac{1}{2}$	$2\frac{1}{2}$	2	$2\frac{1}{2}$	$2\frac{1}{2}$			
6,600	....	(5) Victoria	25	1	....	$\frac{3}{4}$	$\frac{7}{8}$	....	....	$\frac{1}{2}$	....	$\frac{3}{4}$	
		(1) Warrington and Newton	100										
6,000	....	(4) York and North Midland	50	1	....	....	....	$3\frac{3}{4}$	....	....	3	$3\frac{1}{2}$	

The above, as we l e the are the prices at the last business transactions. But it is to be understood that there diffe between the prices a person can sell at and those he can buy at, the former being less than the latter. The prices obviously include the sum paid for the Share; and therefore the difference between them and the price paid on the Share is the premium or discount of the Share. Where there are blanks no business was done. We have carefully corrected the list of the Number of Shares wherever we could; but should any errors be left we shall immediately correct them when pointed out.

Advantages to be obtained by the application of Kyan's Process to Timber, &c.

PREVENTION OF DRY ROT.

The Process here employed completely, and with certainty, prevents the possibility of the destructive effects of the active principle which Nature employs to cause decomposition and decay. When this principle is exposed to moisture within certain degrees of temperature, fermentation commences, and, under various forms and modifications, proceeds from partial to total decomposition. Corrosive Sublimate neutralizes this primary element of fermentation, forming a new chemical compound, which is solid, insoluble, inert, and does not attract moisture. By this chemical change, the fibre of the wood is rendered as indestructible as charred timber, when, by the action of fire, the same fermentative principle is totally decomposed or destroyed.

APPLICATION OF THE PROCESS TO CANADA AND BRITISH TIMBER.

Canada timber is much more liable to decay than that grown in the northern parts of Europe, and for this reason has never hitherto been used in buildings of a superior description. The principle of decay being destroyed as above shewn, this objection is no longer in existence, and this kind of timber may now be employed with as great security as that of a superior quality and higher price.

The same observation applies with great force to timber of British growth, particularly to that of Scotland, much of which is at present considered of very little, if any value, for durable purposes, on account of its extreme liability to decay, whether in exposed situations or otherwise. The present process will therefore render of considerable value plantations of larch, firs of all kinds, birch, elm, beech, ash, poplar, &c. which are the chief products of the great wooded estates, and which, when prepared, may be advantageously employed to most useful purposes.

Extracts from SIR R. SMIRKE's *Evidence before the Select Committee, on Timber Duties.*

Do you know Kyan's Patent?—Yes, I do.

What is your opinion of that patent?—I think it extremely valuable.

Supposing it were applied to the yellow Canadian Timber, would it render it equally fit for the purposes to which you now usually apply Baltic timber?—I applied it to YELLOW CANADIAN PINE, about three years ago, and exposed that wood to the severest tests I could apply, and it remains uninjured, when any other timber (oak or Baltic wood) would certainly have decayed if exposed to the same trial, and not prepared in the same manner.

Have the goodness to state to what trial you subjected it.—I took a certain number of pieces of wood, cut from the same log of YELLOW PINE, from POPLAR, and from SCOTCH FIR; these pieces I placed first in a cesspool, into which the waters of the common sewers discharged themselves; they remained there six months; they were removed from thence, and placed in a hot-bed of compost, under a garden frame, they remained there a second six months; they were afterwards put into a flower border, placed half out of the ground, and I gave my gardener directions to water them whenever he watered the flowers; they remained there a similar period of six months. I put them afterwards into a cellar where there was some dampness, and the air completely excluded; they remained there a fourth period of six months, and were afterwards put into a very wet cellar. Those pieces of wood which underwent Kyan's process are in the same state as when I first had them, and all the others to which the process had not been applied are more or less rotten, and the poplar is wholly destroyed.

Yellow pine would still remain fit for those peculiar purposes to which it is, you say, appli-

cable; but not to other purposes to which the Baltic is applicable?—There are many purposes where it may be used, not depending upon strength, such as ceiling joists, and in some parts of partitions, and in other parts of a house.

Would not the lightness be there a great advantage?—I do not think that is of importance; but the advantage of the process is that it renders such an inferior wood as the poplar useful.

Do you recollect whether any injury was done to the fibre of the wood by the use of it?—I could discover none. As another example of the effect of the process, I may mention, that about two years ago, in a basement story of some chambers in the Temple, the wood flooring and wood lining of the walls were entirely decayed from the dampness of the ground and walls; and to repair it under such circumstances was useless. As I found it extremely difficult to prevent the dampness, I recommended lining the walls and the floor with this prepared wood, which was done; and about six weeks ago I took down part of it to examine whether any of the wood was injured, but it was found in as good a state as when first put up.

What is the effect on the nails?—I have observed no effect upon them.

You did not find that they were more liable to rust?—No; I have used it in a very considerable quantity of paling nearly three years ago; that paling is now in quite as good a state as it was, though it is partly in the ground.

Of what material was that composed?—Of yellow pine; some that I put up the year before without using Kyan's Process (yellow pine), not fixed into the ground, but close upon it, is decayed, and the lower part of it was cut away last year.

Is the process very expensive?—No.

Did you steep the wood yourself?—No; I had it done in London and sent it down.

This preparation of Mr. Kyan's resists all rot;—"I CANNOT ROT IT,"—added Sir Robert Smirke.

THE PERFECT AND CERTAIN SEASONING OF TIMBER.

A desideratum almost as important as the prevention of Dry Rot, and for many domestic purposes more so, is the perfect and certain seasoning of Timber. To effect the seasoning of Timber in the usual way, it is left seldom less than three years, and often as long as six or eight years, protected from wet, but exposed freely to the air. By this means the destructive principle is dried, and under common circumstances rendered inert. But when the Timber is afterwards exposed to great moisture, &c., (the fermentative principle being soluble when merely dried) it will sometimes be again called into action. The patent process for the prevention of Dry Rot not only altogether destroys this principle, and renders it inert, but, by making it solid and perfectly insoluble, prevents the action of moisture altogether. It thus loses its hygrometric properties; therefore Timber prepared by Kyan's Process is not liable to those changes of atmosphere which affect that which is seasoned in the common way. It is scarcely necessary to point out the great importance of the process, in this point of view, to joiners, cabinet-makers, &c. &c., in as much as all wood, including mahogany, and the finest and most expensive woods, may thus be seasoned with the greatest certainty and perfection in the short space of two months, instead of the years at present employed.

Copy of Mr. Ward's Letter.

SIR, *Dorset Street, Salisbury Square; July 5, 1834.*

Having made trial of "Kyan's Patent," as regards its efficacy in seasoning the material to which it is applied, I have much pleasure in stating its complete success in both the experiments I have made; the particulars of which are as follow:

No. 1. HISPANIOLA MAHOGANY—	Cut out of the log - -	March 9, 1833.
	Sent to be saturated - -	April 12, 1833.
	Used in a wrythed handrail,	June 21, 1833.
No. 2. HISPANIOLA MAHOGANY—	Cut out of the log - -	March 25, 1831.
	Sent to be saturated -	June 4, 1833.
	Used in a clampt flap and frame,	August 30, 1833

In neither of the above instances has there been the least shrinking of the wood since it has been used, nor has the colour of the mahogany been at all injured by the process.

I am, sir, your obedient servant,

GEORGE WARD.

PRESERVATION OF CANVASS, CORDAGE, &c. FROM MILDEW, &c.

When canvass, cordage, calico, &c., are exposed to moisture at the usual temperature of the atmosphere, the decaying principle which they possess, in common with all other substances of vegetable and animal origin, is particularly active, and will, in the course of a few weeks, destroy their texture to such a degree that they will not even hold together. The corrosive sublimate acts precisely in the same way as on Timber, neutralizing the element of decay, converting it by mutual combination into an insoluble, inert, and indestructible compound, which therefore cannot be removed by subsequent moisture or wet, but becomes as much a part of the cloth, &c., as the fibres of which it is composed. The destructive principle being removed by being rendered inert, moisture has no longer any substance on which it can act, and the fibre is preserved in its full strength.

Evidence of Sir J. MAY *and Professor* FARADAY, *before the Commissioners appointed by the Admiralty, to report on Mr. Kyan's Patent.*

Colonel Sir John May, Inspector of the Royal Carriage Department, Woolwich, delivered in a paper, containing particulars of the experiments at Woolwich Arsenal, on some pieces of canvass and cordage prepared after Mr. Kyan's process. The pieces of cordage and canvass were produced and examined. A piece of prepared cordage of five inches, with a duplicate piece of white unprepared cordage, were produced, which had both been submitted to the same trial. The prepared piece was quite sound, the unprepared rotten. The same results were observable in two pieces of 2½ inch and 1½ inch cordage prepared and unprepared, as also in two pieces of tent line. In regard to the canvass, four prepared pieces were not affected with mildew; three unprepared pieces were affected with it, and one of them was quite rotten.

Professor Faraday—stated he took some pieces of canvass which had been dipped, and dried and washed them three or four times in hot distilled water, and found that such canvasses, which were put on a board, by the side of unprepared canvass, in his cellar, against a damp wall, were preserved, while the unprepared decayed. His conclusion was, and is, that very small quantities will preserve the matters from decay, and that such canvass in the form of a tent would not produce any unwholesome atmosphere within, by any matters which the waters would have left behind. As to the point of health, he examined a builder of the Samuel Enderby on the subject, before Lord Auckland and the Board of Admiralty, and refers to his examination on that occasion, as strengthening his opinion that the process is not prejudicial to health.

Copy of Letter from Charles Farquharson, Esq., Captain of the "Lord Hungerford."

London; June 13th, 1836.

SIR,—Having just returned from the East Indies (in the command of the "Lord Hungerford,") I am anxious to do justice to Kyan's Patent Process, for the prevention of that Mildew in Sail Cloth which causes their certain decay, by detailing to you facts under my own observation.

In order to satisfy myself of the alleged efficacy of the Process on my departure from England last August, I had an Awning made partly of common canvass, and partly of the same canvass having been submitted to the Patent Process, considering this the fairest way of judging of the difference. The result proves that it was so, and by the end of the voyage, I consider that I had most decisive proof of the preservative power of the Patent Process. The portions of the Awning which had undergone the process are perfectly sound and clean; whereas, *those made of the common unprepared canvass are quite mildewed.*

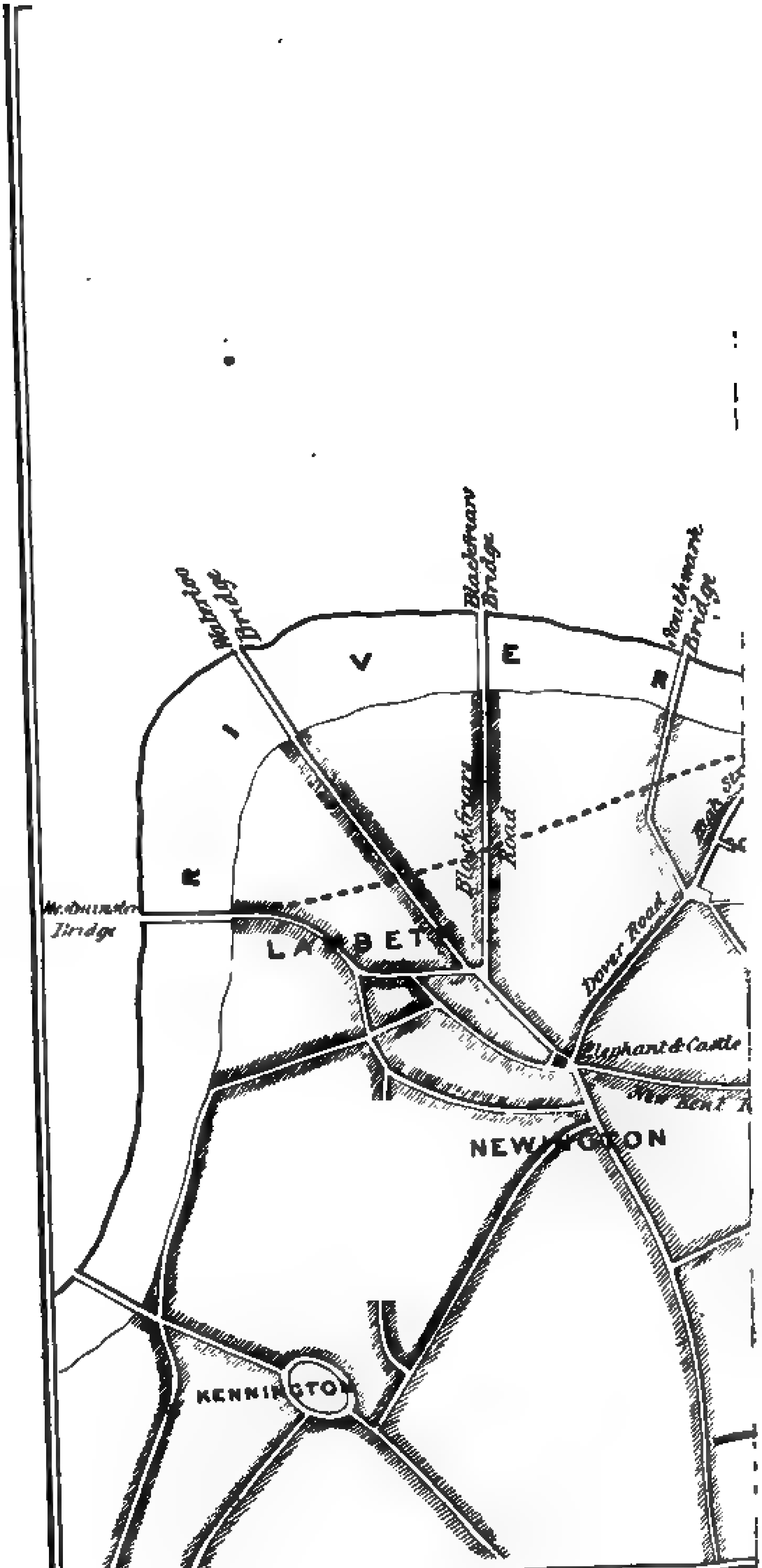
You are at perfect liberty to make use of this letter, and I have much pleasure in affording to your Company so satisfactory a proof of the efficacy of the Anti Dry-Rot Process.

I am, Sir, your's obediently,

CHARLES FARQUHARSON.

"To the Secretary of the Anti Dry-Rot Company."

J. and C. Adlard, Printers, Bartholomew Close.



Madeley, lith. 3, Wellington St. Strand

THE

RAILWAY MAGAZINE;

AND

Annals of Science.

No. VI. AUGUST, 1836. NEW SERIES.

MATHEMATICAL LAWS OF RAILWAY TRANSIT.

BY THE EDITOR.

[Continued from p. 165.]

Velocity of Transit.

BY what has been shown, it is evident that the first principle of locomotion is the hold or bite of the wheels on the road. Unless this exceed the amount of traction force, steam-power is 'thrown away, the wheels will slide round, and no motion can ensue, or be kept up, after it is attained. When the bite is ample, and the steam turned on upon a stationary engine, its want of vent rapidly raises the temperature of the boiler, and, consequently, the quantity and pressure of the steam on the piston. A gradually increasing motion is the consequence. But as this motion increases, so do the strokes of the piston and consumption of the steam; and it results, that the temperature of the boiler sinks again, until it has reached that point at which the temperature carried off by the consumed steam, balances that communicated by the fire to the boiler. At this point, a uniform motion in the train will commence, and be maintained, without any regard to the bite of the wheels being in excess of the traction of the load. An engine of a less weight will therefore preserve that velocity it could never have given. However, it will in all cases be advisable to have more bite than is wanting; especially as the expense of propelling an additional ton or two is immaterial, and might always be made up in the structure of the carriages of the train. Objections I know arise to weighty engines, but where the question is one of efficiency or inefficiency, there is little room for choice. I would much rather increase the strength of the rails, which, wearing but little,

will be thrown chiefly on the first cost, than be deficient in that which is indispensable for success, namely, power in the engine.

If we suppose a piston one half the area of another, it must evidently travel with twice the velocity to consume the same quantity of steam at the same elasticity and temperature, and its force will, of course, be just one half. Therefore a half load, under such a circumstance, would be driven with a double velocity. In the same way a third and fourth of a load would be driven with three or four times the velocity; and, generally, other things being alike, the velocity would be inversely as the load, the area of the piston varying as the load.

But supposing the piston and fire to remain the same, what would be the velocity of a double, triple, &c. load? This is a question which I am not aware has ever been satisfactorily answered, physically or experimentally. Indeed, on the received doctrine of airs, I do not think it admits of an answer. I shall endeavour to solve the problem physically, on the only reasonable principle I can imagine, and on laws of aeriform bodies published and constated with experiment by me fifteen years since in the Annals of Philosophy. It will immediately be seen that the solution of this problem will have the merit of bringing within the grasp of physical science one of the most important points in the action of the steam-engine.

The principle referred to is this:—*That the number of steam particles emitted every moment, drawn into the temperature of the steam, is always proportional to the heat simultaneously communicated by the fire to the water.*

If, therefore, the heat communicated be uniform, and N denote the number of particles momentarily emitted, and T the true temperature of them,

$$N\,T \text{ is a constant quantity.}$$

But if E be the elasticity of the steam, and n the number of its particles contained in a given space,

$$E \propto n\,T^2,$$

by Prop. 8, Annals for May 1821, p. 345. And if V be the velocity of the piston, n V is evidently as the number of particles of steam momentarily carried off or emitted. Therefore,

$$n\,V \propto N, \text{ and } T\,n\,V \propto N\,T \text{ a constant.}$$

Hence

$$E \propto nT^2 \propto \frac{1}{TV} \times T^2 \propto \frac{T}{V} \propto \frac{\sqrt{F + 448}}{V},$$

(according to Cor. 2, Prop. 1, p. 98, Annals for Aug. 1821,) F being the Fahr. temperature. But E, the elasticity, will be as the load or force of traction, and V as the velocity of the engine. Consequently

$$\left(1 + \frac{h}{22}\right)WV \propto \sqrt{F + 448} \ldots\ldots\ldots\ldots\ldots\ldots(4)$$

Moreover, because when the elasticity of steam, at its proper tension, is tripled, the right hand member of the equation will increase only about 5 per cent., we may consider this member constant for all practical purposes; and hence the velocity of transit, other things alike, will be inversely as the load and force of traction; that is, it will be inversely as the product of the load and the force of traction in No. (3).

In the above solution I have assumed that the steam is in no way throttled in its passage from the boiler to the engine, and that the fire continues to communicate the same quantity of heat under every velocity. The former circumstance, though most essential, I have reason to apprehend is not satisfied in any engine yet made when the velocity is high; but it is out of any one's power, without having the exact measures of every part of the engine with many other data, to make a just allowance for the defect. With regard to the constancy of the fire, gentlemen who have had great experience with locomotive engines have assured me that the fire loses much of its vivacity and vigour with the diminution of velocity in the engine. Probably this may be the case; and I think there is an experiment of mine made on one of the Manchester inclines which confirms it, but as I have not repeated the calculations I at present do not like to adduce it. However, one of the reasons brought to support it is very good. They say that as the discarded steam is used in being discharged up the chimney to blow the fire, and as there is a greater quantity so discarded at high than at low velocities, the current of air to the fire, and consequently the intensity of the fire, must be greater in the former than in the latter case. But another argument that I have heard is, taken *per se*, most fallacious. It is urged in proof of the fire being stronger at high than at low velocities, that the quantity of water evaporated with a high velocity is greater than with a low. Now it has long since been proved by myself in the

coincidence of the laws deduced with facts, that the superincumbent steam is perpetually condensing on the water according to its temperature and density, and the water perpetually evaporating without any regard to the quantity or density of the steam over it. When these counter-operations balance, then and then only it is that the steam or vapour reaches what Dr. Dalton has very appropriately called its tension. At this time the water is apparently not evaporating at all, yet in reality its absolute evaporation is just as great, its temperature being the same, as if the steam was carried off momentarily as produced. Hence the apparent evaporation under such circumstances is no measure at all of the real, nor therefore of the intensity of the fire.

Mathematicians will immediately perceive that the direct solution of the above problem—that of finding the velocity under a change of load, the velocity under a particular load being given,—simple as it appears, is beyond the reach of the ordinary principles of science. That clumsy application of the dynamical principle that a given force will generate double, triple, &c. velocities in half, third, &c. weights which one individual has used, is here perfectly absurd and ridiculous, and only tends to prove that the man who wrote it was treading on ground to which he was a stranger. Mr. Wood and Mr. Pambour have both endeavoured to give formulæ for the relation of the velocity to the load, but they are merely empirical, and the latter gentleman seems exceedingly careful not to endanger the credit of his calculated comparisons with facts, though it would seem he is not deficient in experiments. In his tabular evidence against the Great Western Railway, Dr. Lardner appears to have used, but without acknowledging whence he had them, the theorems I have given above, which I had then not long published.

If a practical rule is wanting, some one velocity on a level must be fixed on to which all must be referred, and the load being found corresponding thereto will be the standard of the engine's performance. In our table we have considered 30 miles an hour to be this standard. Now, *if thirty times the weight of the whole train corresponding to thirty miles an hour, be divided by the product of the weight of the whole train multiplied into the force of traction found by the foregoing rule, the quotient will be the velocity in miles per hour of the engine's performance up or down the given plane, supposing the whole steam to be applied, the resistance of the atmosphere nothing, and in descents that the velocity does not exceed* 40 *or at most* 50 *miles an hour.*

Our reasons for limiting the velocity on descending planes evidently arise from considerations of safety. With the present construction of engines it would be unwise to go faster. Besides, it is not improbable but that at higher velocities the rate at which the piston retreats from the steam would bear such a ratio to the velocity with which the steam follows it, as sensibly to disturb the law we have investigated. On planes descending even much within the limits of 19 feet a mile, it is obvious the velocity would be fearfully high, owing to the force of gravity becoming so great and leaving so little for the engine to do. It is for this and other reasons that I have confined the table to descents of under 11 feet per mile, which are now probably greater than full steam can ever be applied to with any passenger trains. But with heavy loads, where the velocity on a level would be much less than 30 miles an hour, full steam may be applied to greater descents.

I have not given a rule for including the resistance of the atmosphere, because there are so many circumstances to be taken into a full consideration of the subject, that I doubt whether it would be in any shape useful for practical purposes, especially in the comparison of lines. However, that those who are anxious on the subject may not be at a loss, I subjoin the following theorem, which supposes the same engine and a still atmosphere:

$$w + \cdot 00048\, v^2 f : W + \cdot 00048\, V^2 F :: V : v \dots (5)$$

In which W, F, V are respectively the total weight in tons, square feet exposed to the resistance of the air, and velocity in miles per hour in one case, and w, f, v the same things in another, the numeral being the weight with regard to load in tons the atmospheric resistance would occasion upon one square foot with a velocity of one mile per hour. In the same train $f = F$, and the ratio of w to W will be that of the forces of traction computed by (3).

Time of Transit.

In all railway questions time is one of the grand subjects of consideration. I shall therefore here give the simplest rule that I know of for its determination. If m be the length of any plane in miles, and V be the velocity the engine can perform with its load in miles per hour on a level, it may readily be shown from the preceding theorems that

$$\frac{60\, m}{V}\left(1 + \frac{h}{19}\right)$$

is the time of its transit in minutes, h being positive or negative according to the plane's being ascending or descending. Consequently if there be a series of such planes, M being the total length of them in miles, and H the sum of all the heights in feet minus all the falls, or the difference of elevation of the extreme points, the time of transit in

$$\text{minutes} = \frac{60}{V}\left(M + \frac{H}{19}\right), \ldots (6)$$

provided none of the descents exceed those to which full steam can be applied. In this as in the preceding theorem H is positive if the second terminus is higher than the first, but negative if lower.

The First Practical Rule, the resistance of the air being disregarded, is—*To the whole length of the line in miles add or subtract, according as the second terminus is higher or lower than the first, the difference of the heights of the termini in feet divided by* 19: *multiply the result by* 60, *and divide by the velocity in miles per hour on a level, and the quotient will be the total time of transit in minutes.*

It follows from the above theorem and rule, that any undulating line will be run in the same time that a line would whose inclination from end to end was uniformly the same. This of course rests on the assumption that each plane is traversed uniformly throughout with the velocity which is properly due to it, and that all changes of velocity, owing to change of inclination, are made without loss of time. Though this assumption is not strictly true, since time, and in some cases rather considerable time, is consumed in every change, yet if an undulating line is taken whose planes are not very unequal in length or number, the effects of the gradual changes from greater to less and from less to greater velocities, will very nearly balance, and render the sum total not sensibly different from what would be produced by our rule on a uniform plane.

Indeed in the comparison of lines it would be endless to go into such minutiæ; nor has it ever yet, to the best of my knowledge, been done. I have not even seen any theorem or method for finding the time or distance occupied in the change from one velocity to another. That nothing, however, may be wanting on this subject, we shall endeavour hereafter to investigate the laws which regulate the changes, generation, &c. of velocity; but the present article has already been extended to too great a length to go into them here.

The rule that I have just given for finding the times of transit presupposes an undulation not exceeding that to which

full steam can be applied in one continuous line. But it so much more frequently happens that the parts of a line are divided by planes which must be descended by a very modified velocity, that I should be leaving the subject in a very imperfect state, and rendering the theorems investigated little better than useless, were I not to show how these difficulties may be avoided.

With respect to descents greater than full steam can be safely applied to, there is no general rule for determining the velocities or times of transit. The velocity admitted must depend on considerations of safety; some may think one velocity some another the only safe one that can be adopted. In the calculation of the times of transit, therefore, on planes steeper than can be worked with full steam, these times must be the subjects of separate consideration. I shall consequently confine the rule I am about to give to all the ascents and to such descents as full steam can be applied to. The perpendicular falls of these latter planes I call the *available falls.*

Second Practical Rule.—*To double the sum of all the lengths of the planes in miles workable with full steam, add twice the quotient of the sum of all the perpendicular ascents minus all the available falls divided by* 19. *The sum will be the time of transit in minutes of all these planes whether continuously united or not, supposing the velocity on a level to be* 30 *miles an hour.*

For finding the time of transit on the steeper descending planes, either each must be computed separately according to the velocity assumed for it, or an average must be taken for the whole, which, in the comparison of lines, is the best way. On this subject of comparing lines I hereafter intend to say something, and to lay down a few simple rules to enable noble lords and honourable members to form an opinion for themselves respecting the merits of rival lines, so as to be independent of, or at least to see through, that disgraceful system of shuffling and tergiversation so frequently practised in evidence before Committees of the two Houses.

I shall here give an example of the mode of calculating the times of transit forwards and backwards on a line, by which it will be seen that our method not only gives the go-by to velocities, but avoids that troublesome way heretofore followed of calculating for each plane separately. It indeed renders the computation for a whole line not much greater than for a single plane, and incomparably less than the method practised for any one plane by many engineers, while in point of accuracy it far exceeds that of calculating for the planes singly.

No. of Planes.	Length of Planes. Miles.	Rise or Fall per mile. Feet.	Total Rises or Falls.
1	3·7	+ 6	+ 22·2
2	5·8	− 5	− 29·0
3	0·3	0	0
4	7·9	+ 14	+ 110·6
5	1·4	− 18	− 25·2
6	7·6	− 21	− 159·6
7	11·2	0	0
8	1·3	− 6	− 7·8
9	8·7	+ 2	+ 17·4
10	2·4	+ 23	+ 55·2
11	9·1	− 14	− 127·4
	59·4		

Let it be required to calculate the times of transit forwards and backwards of the annexed table of gradients, assuming full steam can be applied to all planes falling not more than 9 feet a mile, and that on descending planes above that, the average velocity is 30 miles an hour, the same as on a level. The plus signs signify ascending planes and the minus signs descending.

Then the only available falls in going are the 2nd and 8th planes; and because the steeper planes are assumed to be run at 30 miles an hour, the same as on a level, we shall have to make no separate allowance for them. Now the sum of 22·2 + 110·6 + 17·4 + 55·2 = 205·4. From this taking 29·0 + 7·8 = 36·8 leaves 168·6, which divided by 19 makes 8·9 nearly. Adding 8·9 to 59·4, the sum of all the gradients, the double of it gives 136·6 minutes = $2^h\ 16^m{\cdot}6$, the time of transit.

Again, for the time backwards the only available falls are those of the 1st and 9th planes, making 39·6. The sum of all the ascents backwards 127·4 + 7·8 + 159·6 + 25·2 + 29·0 = 349·0, which diminished by 39·6 and divided by 19 gives 16·3. Double the sum of this and 59·4 makes $151^m{\cdot}4 = 2^h$ $31^m{\cdot}4$ for the time of transit backwards.

Now the only circumstance that could affect the above times of transit, provided the fundamental velocity on a level remains the same, is, as I have before hinted, the rate of running down the steeper planes. If a greater velocity than 30 miles an hour is assumed, it is plain the time will be less than we have given; and if a less velocity, the time will be greater. Calculating as above for the whole line at 30 miles an hour on a level and down the steeper planes, the general rule for estimating and introducing the difference is the following.

Rule—*Take the difference between* 60 *and double the assumed velocity down these steeper planes in miles per hour; multiply the difference by the lengths of the said planes, and divide the product by the assumed velocity. If the assumed velocity is less than* 30 *add the quotient just found considered as minutes, but if greater subtract it from the time before determined, and the result will be the total time of transit.*

For instance, if the assumed velocity is 40 miles an hour, we shall have $\frac{80-60}{40} = \frac{1}{2}$ times the lengths of the planes for the correction of the times. Now the 5th, 6th, and 11th planes are those going down to which full steam cannot be applied in the direct course, and the 4th and 10th in the back course. The united lengths of the former are 18·1 miles, and of the latter 10·3 miles. Therefore $\frac{18\cdot1}{2} = 9\cdot0$ and $\frac{10\cdot3}{2} = 5\cdot1$ are the minutes to be subtracted from $2^h\ 16^m\cdot6$ and $2^h\ 31^m\cdot4$, the times before found.

[To be continued.]

ON THE HABITUDES OF IRON AND STEEL.

By C.

To the Editor of the Railway Magazine.

Sir,

In the last number of your Magazine I noticed some observations by Mr. Maugham on the conversion of iron into steel. From the reputation of this gentleman as a scientific experimentalist, his opinions necessarily have considerable weight, and I am therefore induced to make a few remarks, conceiving that his deductions are grounded on insufficient evidence, and that the practical applications he would draw are not tenable.

The fact which he mentions of iron in a state of fusion not decomposing water, is of considerable interest as a philosophical question, but is, I conceive, quite unimportant in the practical point of view which he anticipates.

First, as a philosophical subject it is interesting, and seems to be borne out by the recently published experiments of the Franklin Institution on the explosion of steam-boilers; on which subject the last number of your Magazine contains some observations by Mr. Perkins. These experiments prove that at very high temperatures a repulsion takes place between heated metal and water, and therefore, I apprehend, while that repulsion continues perfect, no real decomposition can take place. This will account for the fact mentioned by Mr. Maugham. Though it is not stated whether, on the iron

cooling down to a certain point, the usual signs of decomposition of the water took place, it cannot be doubted that that effect must in reality have been produced, unless we imagine that the experiment in question had deprived the iron of this quality, which there is no reason to suppose, and which has never yet been known to have been accomplished. But a very satisfactory explanation may be found, provided the Franklin experiments above mentioned be correct. If the repulsion between iron and water be perfect when the former is at a red heat, or about 800° of Fahrenheit, as the temperature of thoroughly melted cast iron is estimated at 20577° of the same scale, the iron would have to be cooled down through 19777° before any effect could be produced. This accounts for the quiescent state in which the iron remained under water for several seconds, as Mr. Maugham states. If the repulsion be perfect at 800°, iron cannot possess any remarkable degree of power in decomposing water through more than about 400° of temperature, and so small a mass of metal as the experiment was performed with would pass through this range almost instantaneously, surrounded as it was with water. The trifling effect of decomposition which would be produced, would therefore, most probably, escape observation, particularly as from the depth of water which is stated to have been over it, there would be an additional pressure of nearly three quarters of a pound on the square inch, which would be considerable in comparison of the small weight of metal used, and the large horizontal surface that would necessarily be exposed, in proportion to its bulk, when dropped into water in the manner stated.

Secondly, as to the practical utility of the experiment I entirely differ from Mr. Maugham. The residual product of his experiment being so extremely hard might necessarily have been anticipated, because he used cast iron which contained the *smallest quantity of carbon*, and therefore approached more nearly to the composition of steel; and also from its having been *hardened* at the highest possible temperature at which this operation could be performed.

Every time that cast iron is melted it loses a portion of its carbon, and becomes harder; and the smaller the casting into which it is run, the greater its liability to become hard, that is, to lose its carbon. The effect seems to be the same as when iron is exposed to the operation of *puddling*, which is in fact raking or puddling it about, when in a state of fusion, to allow the escape of the gaseous carbon, and fits it for being made into rolled iron. Now the running of cast

iron into very small moulds has something of the same effect; it divides the mass into more minute portions, and thereby allows greater facility for the gaseous escapement. We consequently find that if two castings be made at the same time, and from the same iron, the one being large and the other small, the large casting will be soft, and the small one probably quite hard. Iron nails are perhaps as hard as almost any article made from cast iron; these when fused would become still harder, and in addition to this the hardening process would be increased to the greatest possible degree by the plan Mr. Maugham adopted, because it is well known that the higher the temperature is raised before the article is plunged into cold water,—which is the usual way of hardening,—the greater the effect produced. The fused cast-iron nails in question would therefore be acted upon by the water the instant they were cooled down to that point at which the repulsion between the metal and the water ceased, and the result would of course be the maximum state of hardness.

The operation of *tempering* may be considered as the reverse operation of hardening: it is, in fact, reducing the state of extreme hardness to that point best suited to the particular object for which the steel is required.

Mr. Maugham's supposition from his experiment that it might be desirable to place the moulds for iron castings under water, would not be found to answer in practice. When the quantity of metal was large, the moment the heat was reduced to that point where the repulsion before mentioned ceased, decomposition of the water would take place; the consequence would be the formation of a quantity of inflammable gas within the mould,—hydrogen, no doubt, mixed with a portion of oxygen,—and an explosion would be the inevitable consequence. In the ordinary manner of making castings, this gas frequently forms in the moulds, and has occasionally been the cause of disastrous accidents: in one instance in particular, a few years ago, at Nottingham, where the greater part of the boiling metal for a large casting weighing several tons was ejected out of the mould by an explosion of this kind of gas, which forced a shower of the boiling metal over several persons who were near. Even in small castings a miniature explosion almost always takes place, arising from the decomposition of the water contained in the sand of which the mould is composed. In addition to this objection, the resulting effect of the intense hardness of the castings would in nineteen cases out of twenty be a most important disadvantage; and last, but not least, the plan

would be an impossibility except in a very few cases where iron moulds are used, because the water would dissolve both the loam and sand of which the moulds for iron castings are usually composed.

It were truly a work of supererogation in your correspondent to attempt proving by arguments that chemists have almost invariably drawn wrong conclusions from their experimental researches into the habitudes of iron: his own letter bears such ample testimony to the truth of the assertion, it may readily be conceded to him that he has fully established that fact. I cannot but observe, however, that scarcely any branch of manufacture offers a wider field, or appears more likely to justify the anticipation of a plentiful harvest for scientific research, than this. If Mr. Maugham will only avoid the *idola tribus*,—the errors into which almost all chemists have fallen, by drawing conclusions from experiments on a small scale, there are none whose talents and resources better qualify them for following out this subject with success than himself. The best experiments of the laboratory must never be depended on; they only afford leading points to which attention should be directed; for the element of heat is so materially altered when practically operating on a large mass to what it is when the experiment is made on a small scale, that similar results are scarcely ever obtained.

But to return to the subject of Mr. Maugham's letter. There can be no doubt as to the possibility of making steel at once from cast iron, without the previous operation of decarbonising and making it into bars. On this subject there is a paper by Mr. Hawkins in the Report of the British Scientific Association for 1832, p. 598, describing the steel for a suspension bridge on the Danube to have been made in this manner in Germany. But although it might be done on a small scale, the cast iron made in this country is not sufficiently pure to be made into steel without passing through the previous processes of refining, puddling, shingling, and rolling; in all of which it successively becomes more and more pure. The minerals used here in the manufacture of iron are by no means so pure as in many other parts of the world, which is of itself sufficient reason why the various intermediate processes of refining become absolutely necessary with us, while they may occasionally be dispensed with in other places.

Although the query which Mr. Maugham puts, Whether iron and carbon combine in definite proportions or not, has never been positively demonstrated, there is the greatest reason to suppose that they do not. The number of combina-

tions appear too great to suppose that they can be multiples of some common number, and the quantity of carbon which iron imbibes increases gradually up to its fusing point, and does not proceed *per saltum*. But after the iron has reached its fusing point, I think, not only does the increment in the quantity of carbon cease, but it gradually recedes back again the longer the iron is kept in a state of fusion. This perfectly accounts for all the various changes which take place. It will explain all the changes which occur in the manufacture of iron into steel; the tempering process; the change in cast iron by repeated fusions; and also the change which cast iron undergoes when it is refined for rolling into bars: it explains also the process of annealing, but will not account for the operation of *hardening*, unless we imagine that the oxygen of the water unites with a portion of the carbon and forms carbonic acid; and as in the order of simple affinities the union of carbon and oxygen is stronger than that of carbon and iron, it is not unlikely this is what really takes place. That something analogous to it happens is certain, as a practised eye will at once detect the alteration by the colour, which is quite different in hard iron or steel to what it is in soft. Another proof is that the quality of iron smelted in hot weather is always much inferior to that made in cold weather; because in the former the air contains much more hygrometric water than at the latter time; and this being forced into the furnace along with the air from the blowing machine, unites with the carbon, is carried off in the gaseous state, and the iron receives too small a proportion of carbon, and is found to be inferior; for the more carbon it contains the richer is the quality.

The length to which these remarks have already extended prevents me from going further into details on this subject, as I fear I have already trespassed far too largely on your pages.

I am, Sir,

Yours obediently,

C.

London, 11*th July*, 1836.

OBSERVATIONS ON THE EXPLOSION OF STEAM-BOILERS.

By Jacob Perkins, Esq.

[Continued from p. 173.]

The experiment of Perkins which is more particularly referred to in the query, is that in which an opening having been made in one of the generators, containing intensely heated water in contact with red hot metal, neither steam nor water escaped, and in which having affixed a pipe and stop-cock to the same vessel, no steam issued through the cock when opened. To repeat this with a view to ascertain, as required in the query, the size of opening to which such a result would apply, three apertures were made, $\frac{1}{16}$th, $\frac{1}{8}$th, and $\frac{1}{4}$th of an inch respectively, in the sides of a wrought-iron mercury bottle; these were closed by conical plugs connected with levers, by which the plugs could be withdrawn from the sides of the bottle. The fulcrums of these levers were attached to the wrought-iron cylinder already referred to, within which, its axis coinciding with that of the cylinder, the cylindric bottle was placed. An earthenware furnace was placed below the bottle and surrounding cylinder, the latter resting upon wrought-iron bars, supported by the edges of the furnace, and the former supported by a stone placed upon the grate of the furnace. Besides affording a support for the levers, the wrought-iron cylinder was introduced to protect the experimenters against injury, should the bottle explode in the trials to be made with it. This apparatus having been placed in a quarry pit, adjacent to that in which the cylindric boilers were burst, water was poured into the bottle so as to fill it; the screw plug was next passed into the neck and forced home by lateral blows from a hammer. A fire was now made in the furnace, and the fuel heaped up so as to fill the entire space between the mercury-bottle and wrought-iron cylinder, and to be about five inches deep above the stopper of the former. A string was attached to the lever connected with the smallest plug and carried up the bank. The fire soon burned briskly, and it was perceived that a small quantity of steam mingled with the feeble smoke and heated air which rose above the apparatus. About twenty minutes after the beginning of the experiments, the leak appearing to increase, an incautious attempt was made to stop it, but without success; at this time the bottle was seen to

be at a dull red heat. It was thought that but little water had been able to escape in steam "through the very minute opening which the imperfect thread of the screw gave, and it was intended to withdraw one of the plugs, when a few minutes should have elapsed to give time for the bottle to be heated to complete redness. Meanwhile a most violent explosion occurred; the body of the bottle rose in the air, the iron cylinder which served to increase the height of the furnace was thrown from its place, the earthen furnace blown to pieces, and the fire scattered far and wide through the woods. After extinguishing the fire, it was found that the iron cylinder, weighing with the apparatus connected with it 61¾ lbs., had been thrown four feet from its bed; the plugs which passed into the bottle had been broken short off at the exterior of the bottle; the bottom had been forced into the ground, which was ploughed up by the fragments of the furnace, and completely wet for a considerable distance around; one of the iron bars supporting the cylinder was thrown to a distance of thirty feet, and sunk three inches into the ground. The body of the bottle was found thirty yards from its position before the explosion, having penetrated two feet into the ground. The noise of the explosion resembled that of a twelve-pounder fully charged. This experiment proved, first, that steam from intensely heated water was able to penetrate an exceedingly small opening. Although it proved nothing in regard to an aperture made in a vessel containing water only, it showed an effect produced when there was very little steam in the vessel. It verified the deduction from theory that but a small part of water, highly heated, can expand into steam if suddenly relieved from pressure. It showed that great danger must be incurred in attempts to heat water very highly, even in vessels where it has but little room to expand itself, contrary to the opinions entertained by many; and that an attempt to repeat the experiment of Perkins, unless with an apparatus capable of sustaining the most intense pressures, must be attended with great danger."

Although it appears that the boiler was first *filled* with water, yet under such tremendous pressure the water and steam would be rapidly discharged through the small fissure which was observed to have made its appearance; and as the water lessened its bulk, so as to leave a space between the metal and water, it would be repelled from every part of the boiler, except at the fissure, which by its blackness would have shown that the temperature of that spot was very much reduced by the issue of the steam and water. If the whole

boiler showed a dull redness, as it was stated to show by the Committee, water could not have been in contact with the boiler, but separated by a thin film of non-conducting material; for had the water been heated to dull redness, a boiler of twenty times that strength could not have resisted that pressure. I have no doubt that the water was of a much lower temperature than the steam in contact with it, or the metal which was in contact with the steam. It was observed by the Committee that just before the explosion the rush of steam increased. This was undoubtedly the cause of the explosion. It has been frequently observed, that when the water had been reduced in the boiler so as to allow the heat to enter above the water and surcharge the steam, as well as heating the upper part of the boiler, and if at this time the safety-valve be suddenly raised, so much so as to take off the steam faster than it is generated, then the pressure would be taken off from the surface of the water, so as to allow it to rise up in mist, and take off the extra heat from the surcharged steam as well as the heat from the top of the boiler, and become completely saturated; at this time an explosion must necessarily take place. Now I conceive that the experimental boiler was under the same circumstances; and when the fissure had increased sufficiently to take off the pressure from the cylinder of water which was in the interior of the boiler, this water would burst into mist, and take up the heat in the surcharged steam as well as the heat of the metal, and produce what was witnessed by the experimentalist. Now if the plug had been withdrawn before the explosion took place, steam and water would have rushed from the hole. How could it have been otherwise? Was not every part of the heated boiler rendered repellant? The aperture was the only place for its escape: thus they would have made it appear that the experiment that I published some time since was entirely fallacious. Now if the Committee will take the trouble to make the experiment as I made it, or as one that was made by Alexander Gordon, Esq., Civil Engineer, of London, they will witness the fact. Mr. Gordon some time since informed me that he had made an experiment to prove whether the facts that I had stated respecting the repellant power of heat were correct. He said the reason he had tried the experiment was, because one of his employers had been much troubled with the burning out of the bottom of a boiler of vertical tubes. The boiler consisted of a group of tubes 3½ feet long, 4 inches diameter, and under ⅛th of an inch thick, standing vertically, a vertical flue 1½ inch up through

each. They were arranged very closely together, and the heat of the fire passed up among and through them. In one of these tubes a series of tubes (having each a blow-cock) ran from the bottom to the top, say 4 or 5 inches apart, were fixed for observing the changes of the water and steam at different temperatures; these cocks were about $\frac{1}{4}$th of an inch of interior space. The fire was now gently made under the bottom of the boiler; the steam soon got up, and was allowed to blow off constantly as fast as it was generated: these tubes contained about two thirds water and the other third steam. When the lower cock was first opened water issued, as was expected at that temperature; this cock was now closed and the top one opened, and the steam rushed out as it ought to have done, at about 200 lbs. pressure to the inch; the bottom of the tube was now raised to a higher temperature; the top was now closed; the fire was urged to a much higher temperature, and the bottom of the boiler showed an approximation to redness, and when the lower cock was opened nothing but elastic fluid issued; this cock being shut, the central cock was opened, and water only issued, evidently showing that all the water was raised from the bottom. Mr. Gordon thought he smelt hydrogen gas from the bottom, but had no convenient test. If my countrymen would make this experiment they would be perfectly satisfied of its correctness, and of what I had formerly stated. I have been extremely fortunate in meeting in London Dr. Hare of Philadelphia, who is one of the Committee of the investigation. Dr. Hare, although one of the Committee, has never attended one of the experiments, having made up his mind that it was useless to attempt to prevent explosions when it was impossible to avoid them. The Doctor's remedy is to prevent mischief when explosions take place; this has always been my practice, although our two systems are entirely different: mine has been to modify the boiler so as to prevent the possibility of explosions, bursts being only the result of too high pressure of the steam for the strength of the boiler. It gives me great pleasure to have so great a man as Dr. Hare witness these new facts, which throw so much light on the science of steam. I shall conclude this paper by requesting my American friends to suspend their opinion of the report of the Franklin Institute (so far as I am concerned,) until the return of Dr. Hare, who I hope will take the very machine used in this country to show the fact.

JACOB PERKINS.

TO THE DUKE OF WELLINGTON ON THE RIGHTS OF THE PUBLIC AND RAILWAY SHAREHOLDERS, AND A METHOD OF INSURING A CHEAP AND IMPARTIAL DECISION ON BILLS FOR LINES.

By the Editor.

My Lord Duke,

No man can doubt for a single moment that the motives which induced your Grace to step forward on the all-important subject of railways are entirely for the public good. Your well-known candour sets you above the suspicion of any other consideration. You have seen these gigantic undertakings proceeding with a velocity, which it has appeared to you, if not speedily checked, will give them an irresistible and a dangerous impetus. Company after company rises, line after line is projected, and million after million of capital is demanded, which in a short time some think would swallow up the whole national wealth and leave us nothing but half-finished railroads for our substance. The monopolizing effects of the companies too, evidently had an influence with your Grace. You dreaded, and apparently on good grounds, that if the carrying business of the kingdom becomes invested in a few companies, it will place the public entirely at their mercy—a situation that every honest man would most justly dread. Nor has it escaped your notice that some of the schemes before the public are little better than organized bodies of * * *, got up God knows how, and containing God knows whom. To protect the public against such projects would indeed be most praiseworthy and beneficial. But how is this to be done? I candidly confess it wears to me the aspect of great and complicated difficulty. We may lay down rules for securing the best line the country will afford; we may without much difficulty insure an impartial examination into the merits of, and a just decision on that line; we may keep the balance even between the shareholders' and the public's interest, so that while we protect the one we shall not unjustly infringe the other: but how we are to meet the innumerable inventions of artful villany, to guard the shareholders, and through them the public, against the concentrated wiles and tricks of designing scoundrels, is a Gordian knot few, I believe, would attempt to untie. To me one method only presents itself, a strong one indeed, but such as the urgency of the case seems to demand, if we would place railroads on that footing that honest men should support them,

and that they should be productive of that lasting benefit to the country they are calculated to afford.

To make railroads what they ought to be involves the accomplishment of four grand points.

First, To find such a line between given points that it shall diffuse the greatest quantity of good to the surrounding country, and be so constructed that the annual interest of its cost and expense of working it with a fair share of traffic shall be a minimum.

Secondly, To insure an inexpensive and impartial Parliamentary or other investigation of the line.

Thirdly, So to regulate the profits, with the interest of the original costs and the working expenses, that the shareholders shall have a fair return for their risk and capital, and the public the benefit of reasonable and expeditious transport.

Fourthly, To protect the shareholders and public against the fraudulent dealings of unprincipled men, whether directors, officers, or others having influence *sub rosâ* in the affairs and management of the company.

Probably a simpler method of securing the objects of the first point cannot be given than my sketch on the "Laying out of Railways" in the 2nd No. of this Magazine, and the outline of a "Plan for insuring the best" in No. IV. p. 143; I shall therefore not detain your Grace with a repetition of the observations here.

With the second point there would be but little difficulty if a change was made in the system. It is plain where men have no fear of a controling power nor any obligatory duties to perform, and where indeed every minute consumed is an unprofitable encroachment on their time, that they will seldom be punctual to attend, or attentive when present. Such is exactly the situation of *honourable members* of the Commons and *right honourable Peers* of the Lords. If they have no interest in the line nor any fear of blame for non-attendance, where is the motive for wasting day after day in listening to an endless repetition of useless questions and senseless answers? If they have an interest, that interest lies in all probability on one side, and how then is it possible for them to become impartial judges? Men are men in every situation of life, whether legislators or not, titled or untitled; and interest is a deity, however fine their feelings or noble their intentions, they all more or less worship and obey. The golden cup of Harpalus with twenty talents gave poor Demosthenes a cold and choked the thunder of his opposition. May not English legislators inherit similar tenderness of constitu-

tion, to which a few shares in the intended line—if no land lies in its way to be benefited—are equally dangerous? At all events a system which exposes their judicial health to such formidable attacks cannot be good. Besides, the manner in which the cases are managed before the Houses are anything but what they ought to be to insure justice, as W. C. F. has shown in our last number. Looking at whatever side of it we please, it is clear that the present plan is bad, and open to improvement. Now it has occurred to me, that if these cases were referred to the ordinary courts of law, before our judges and a common jury, the chances of a speedy and just decision would be much greater. Increasing the number of judges would enable them to despatch the business before them so as to attend to matters of this sort, and particularly if a little use was made of the long vacation. An augmentation of salary would of course be needful, which might very well be paid by the Government charging each company that came for a bill a certain sum, either per day, week, or otherwise, so as to save the public purse. The juries too might be paid, but not directly by the companies. Judges being independent of all parties, compelled to attend from the duties of office, able from their education to meet and control the manœuvres of counsel, and having that grand desideratum for the despatch of business, unity of action, would in my opinion get through more cases in a week than a committee would in a Session. And if they were inclined to peculate, the risk of place, with the controling influence of the public press, and the impossibility of screening themselves by throwing the sin upon a body as in committees, would be powerful checks. If it be urged that ordinary juries would be incompetent—which I am by no means satisfied of, under the guidance of a judge—let them be composed of men of science and engineers, who should be liberally paid after decision by a tax on the company, ordered by the Parliament or judge. And let these too be amenable to public opinion by the publication of their several reasons for their decision, having previously made these jurors as honest as possible by severe oaths, embracing the past, present, and future tenses, of having no direct or indirect interest, connexion, or benefit from the proposed measure, its friends, or advocates. If all such proceedings were published six months prior to their being brought under the notice of Parliament there would be time for investigation; and if the cases were then finally disposed of before the whole House, there would probably be but little reason to complain hereafter of haste or want of justice. We should by this means save much valuable time to the members of the Houses, and

the waste probably of some millions on injudicious schemes, which a few years may show to be so worthless as to compel the construction of better.

On the third point no person can doubt your Grace's intentions are honourable to all parties. Fearful of the consequences of overgrown monopolies, you are anxious to put some salutary restrictions to these bodies riding, as you apprehend, roughshod over the public; and you are anxious to do this before they become too powerful to be ruled. Every honest and rightminded man must be satisfied that such are needful; nor is there a company got up on honourable principles that would object to any reasonable measure, in which a due regard is paid to their own interests, and a proper consideration is had to all the circumstances of their situation and risk. But in common fairness these must be taken into account. No man knows better than yourself that these works, if they are at all likely to be beneficial to the nation—which every one in his sober senses admits—will form a great and brilliant æra in its prosperity. Nay, my Lord Duke, permit me to ask you if they have not been a Godsend towards the preservation of this country, by giving a new impetus to industry and trade, and saving us from that anarchy and confusion to which distress was fast hurrying a large portion of our population? With all these advantages staring us in the face what have the Government done to promote railways? Have they done a single thing? I am not conscious of one. Have they removed a single impediment? Not to my knowledge; but they have raised several. Have they contributed a single farthing? Rather I believe, by the intolerable and vexatious oppositions permitted in passing the bills, have been the cause of spending many hundred thousands, which, like another national debt, will prey to the end of time on the vitals of public industry. But if no active measures have been taken in favour of railways, one might at least have supposed silent encouragement would have been given them. Facts however tell a lamentably different tale. What has occasioned the panic which has for some time existed in railways and deterred men from investing their money in these undertakings, but the premature and injudicious interference attempted in their presumed profits, which however we are happy to see the good sense of the Commons has rejected? Premature it certainly is to an absurd extent to talk of curtailing profits seven years before they come. And nationally considered, nothing surely can be more injudicious than to discourage men from doing that which will benefit the country, and which the Government

will not do. As to the companies themselves, it amounts in my opinion to downright injustice. All that the public have a right to expect are economy and despatch, which must be amply proved before a bill can be obtained. Presuming these things secured, what right have the public to go further and claim a copartnership in profits, without advancing a farthing of capital or risking a single shilling? What a glorious doctrine it would be to set up in trade, that a man, besides rendering an article very cheap and much accommodating his customers, should be obliged to divide the fruits of his industry among them into the bargain! Perfectly parallel is the case in railways. The cheap article is the carriage, and the accommodation the despatch in transit. But it will be worth our while to inquire into the probable value of those profits the legislature is so anxious to divide among the public. For this purpose we will take one of those cases which promises the irresistible profit of 20 per cent. Now we all know, speaking generally, that paper profits of this kind are, like the rumoured fortunes of young ladies, about three times the reality. But to be very liberal, we will suppose they are only double, which will reduce the 20 to 10 per cent. Again, if we regard the trouble, difficulty, risk, &c. of procuring a bill, the chances of getting and losing it are about equal; so that the 10 per cent. now comes down to 5. Moreover it may fairly be estimated from five to seven years before the line comes into profitable working, if it be of any length and any difficulty. About 1 per cent. more may be taken off on this account, which will reduce the probable value of the 20 per cent. speculation to 4 per cent., a great sum indeed for the public to envy, or the Government to interfere with.

If, however, the public must be partners in matters in which they have done nothing, advanced nothing, nor risked anything; if

> "They soundly sleep the night away,
> And just do nothing all the day,"

and yet will participate in the good things of other people's industry, why then let them be partners in the strict sense of the word, and let them share the loss as well as the gains of companies. Guarantee but six per cent. to the shareholders generally, and I will venture to assert there will be few companies, amidst all their golden promises of 20, 30, or 50 per cent. profit, that will not suffer the public to take every particle of the surplus, and cordially thank them for their kindness. But to claim a portion of the good and to bear no part of the bad savours, my Lord Duke, of avaricious madness;

not of sober reason; of Turkish tyranny, not of English justice. Interfere not, let me beseech you, with these projects now, unless you wish to crush them in their infancy, and to deprive the country of their benefits. If some parties make a good hit, let them enjoy it; they deserve it, for their spirit and judgement; if others make a bad, let them bear it. As to legislating for a limitation of their profits, it will answer no good purpose; it will end in disappointment to the public and robbery to the shareholders. Hundreds of ways will be contrived to defeat the object: office on office will be created, and all beyond the legal profits of the concern, instead of going to the shareholders or advantaging the public, will be eaten up by idle drones and useless hangers on. Who knows but we may by-and-by see some noble duke, instead of wishing to succeed our brave Constable of Dover Castle, trying for the Constableship of some opulent railway; the Master-General of the Ordnance resigning, to become Master-General of the Traffic; and the Commander-in-chief of His Majesty's forces turned into Commander-in-chief of the Locomotives, with a salary as much above his former as the power of a steam-engine is above that of a popgun? It is, indeed, impossible to tell what would be the end of an injudicious attempt to limit the profits of railway companies. Turn the profits from the pockets of their rightful owners, the shareholders, and they will assuredly go to some worse purpose, but never to the advantage of the public. If Your Grace wishes to benefit the public and secure the shareholders, it must, in my opinion, be by some such simple rule as the following, namely, never to grant a bill unless it can be shown that the time of transit will not exceed a half of the present by the road; secondly, that the expense of carriage of any goods claimed, or expected, to be carried, shall not exceed two thirds of what it now costs; thirdly, that the probable profits to the shareholders shall not be less than ten per cent.; and lastly, that whenever two thirds of the persons expected to be benefited by the railway show, either through mismanagement of the directors or otherwise, that they have not that benefit they ought to have from the line, either an entirely new set of directors shall be chosen or a new line permitted to be made. By the first two we should, it appears to me, give the public all they have a right to, and crush in the bud those schemes that will not bear investigation; by the third we shall protect the shareholders; and by the last, keep the rein needfully tight over the directors, to which none that are honest will object.

I ought now to discuss the fourth point; but as I am no novelist, and can only draw my characters from real life, it is a subject on which I could not touch without giving pain to some truly honourable individuals unfortunately mixed up with others, who, if they had had their deserts, ought long since to have been banished from this country, and from the society of all honourable men. Besides, I am in hopes that in one case the parties themselves will see what is due to their own fair characters, and not permit a little surface talent, which is always the property of a villain, to keep among them one with whom they can never associate but with disgrace, even if he does not at last much more seriously involve them. In another case I hope the parties, however they may have acted before, will in future act honourably and honestly, or they may find, to their astonishment, a few little tricks laid bare which they think none but their own snug coterie knows, and which will inevitably frustrate all their future manœuvres. To a third I would recommend an instant and thorough purge; for if drastic medicines are good in the body of a man, they will be equally so in the body of a committee; and I can assure the parties I allude to, that they can get rid of a few ulcerated members without any loss to themselves or their object.

It will not be my wish to enter into these matters, but if I do I shall proceed fearlessly and boldly. In the mean time I remain, very respectfully,

Your Grace's obedient humble Servant,

THE EDITOR.

REVIEW OF RAILWAY BOOKS.

"*Principal Elements in the Comparison of different Lines of Railway.*" *From* "*The Means of Comparing the respective Advantages of different Lines of Railway, &c., by* JOHN MACNEILL, *Civil Engineer, M.R.I.A., F.R.A.S., &c.*"

IN a former number we noticed this useful little volume. The following article, which is on a matter of considerable interest, will better display the clear and simple style in which the book is written, than the most elaborate description we could give.

"The interest of the country is, in this respect; 1st, The establishment of a very rapid mode of transport,—a consi-

deration which should give a preference to the shortest lines, the velocity being supposed to be the same on all; 2nd, The increase of wealth. The construction of a railway, like that of a canal, or new road, is favourable to the advancement of wealth, in the first place, because the actual expense of transport in this direction is diminished; and in the second place, because this diminution in the cost of transport increases the value of the neighbouring properties, facilitates the establishment of new works, and increases production. The first of these two effects, that is to say, the diminution obtained on the actual cost of transport, is the cause of the second; so that this diminution is the principal circumstance, and that which should be especially considered.

"We should even say that the rate of reduction which is obtained upon the actual cost of transport, by the establishment of a new communication, is almost the only circumstance which should be thought of, if it were not necessary to consider also the quantity of goods which is carried, or may be carried hereafter, in this direction; for it is evident that it may be less advantageous to the country to produce a great economy in the cost of transport upon a line where there is little to carry, and more advantageous to produce a less economy upon a line where a large quantity of merchandise is carried. It is therefore generally necessary to take into consideration, in the comparison of different lines, the quantity of traffic which may be established on each, and even the increase in the value of properties, and the developement of production, to which the establishment of these lines may give rise respectively, according to the nature of the countries which they traverse.

"We shall not here undertake to go minutely into the influence of these last elements of the question, which rather belongs to statistics and to political economy, and with respect to which we cannot offer at present any precise opinions; we shall therefore confine ourselves to the consideration of the reduction which the establishment of a railway can effect upon the actual cost of transport, a most important consideration, to which, as already remarked, it is always necessary to attend. This will form in every case the principal element of the comparison which is the subject of inquiry, and often lead to determinations purely geometrical or mechanical, and consequently exempt from arbitrary deductions.

"The cost of transport upon a railway, as upon a road or canal, depends on two principal points, which it is necessary to distinguish and consider separately. The first of these is

the expense of constructing the railway, and the second is the expense of conveying the goods on the railway when it is constructed.

"The expense of the construction of the railway is independent of the quantity of merchandise or of passengers that will pass over it. The expense of transport, properly speaking, upon the railway supposed to be constructed, depends, on the contrary, upon the quantity of merchandise or of passengers; that is to say, upon the tonnage; all other things being equal, the expense will evidently be proportional to the tonnage.

"As to the secondary expenses, such as the annual cost of repairs and management, it may be said that they are partly in proportion to the expense of the construction, and partly to the amount of tonnage.

"We may therefore admit, without falling into any serious error, that the annual cost of transport on a railway is in all cases formed of two parts, the one proportional to the expense of the construction of the way, and the other proportional to the amount of tonnage.

"We should also observe, that the cost of transport of one ton of merchandise cannot be specified, unless the number of tons which shall be carried annually from one extremity of the line to the other be known.

"Suppose, for example, that we know, in one case, that, the road being constructed, the part of the expense which is proportional to the tonnage will amount to 0·30 fr. per ton, per league; or [=1*d.*] per ton, per mile; and in the other case, that the part of the expense which is proportional to the cost of construction, and which is independent of the tonnage, represents a capital of 1,200,000 fr. [=£48,000,] or an annual expense of 60,000 fr. per league, [£800 per mile.]

"This annual expense, if the railway has a traffic of 100,000 tons per annum, will amount to 0·60 fr. for each, and if the traffic be 200,000 tons, it will amount for each to 0·30 fr.; so that in the first case, the total cost of the transport of one ton over one league is 0·90 fr., or threepence per ton, per mile; and in the second case it is only 0·60 fr. per league, or twopence per ton, per mile.

"The knowledge of the expense of construction of a railway, and even, to a certain extent, that of the expense of repairs and management, are subjects which do not differ from those in which engineers are generally employed, and which do not require any particular consideration.

"The knowledge of the expense of conveyance, properly speaking, requires an investigation similar to that which is

made in the arts, for ascertaining the price of works executed by machines. It depends upon mechanical principles, to which we shall particularly apply ourselves."

"*The Practical Mechanic's Pocket Guide*," by R. Wallace.

A VERY handy little book, under the above title, has just come under our notice, in which there is a vast collection of useful matter, generally very well arranged, without any ostentatious display. The following extract respecting the "proportional parts of a steam-engine" will give a tolerable specimen of the concise style and manner of the author.

"In all kinds of steam-engines the length of the cylinder should be about twice its diameter, so that the steam may be bounded by the least possible quantity of surface. According to Tredgold, the velocity of the piston in feet per minute should be 98 times the square root of the length of the stroke, in an engine for raising water; and 103 times that length in one for driving machinery. Also, the area of a transverse section of the steam passages should be the 4800th part of the product of the velocity of the piston in feet per minute, and the area (in feet) of a section of the cylinder parallel to its base.

"In the common atmospheric engine, if this area be multiplied by half the velocity, and the product by 1·23, added to 1·4, divided by the diameter, the result, divided by 1480, gives the number of cubic feet of water required for steam per minute. If the difference between 1220° and the temperature of condensation be divided by the difference between that temperature and the temperature of the cold water, the quotient will be the number of times the quantity of water required for injection must exceed that required for steam, which is generally about twelve times. The aperture for injection must be such as to admit that quantity during the time of the stroke. The head of water should be about three times the height of the cylinder. When the jet apertures are square, the area of a section should be the 850th part of the area of a section of a cylinder. The diameter of the conducting pipe should be about four times that of the jet.

"In the atmospheric engine with a separate condenser, the capacity of the air-pump should be one 14th part of that of the cylinder; or, making the stroke of the air-pump half that of the steam-piston, its diameter should be $\frac{3}{8}$ths of the diameter of the cylinder. If the area of a section of the cylinder

be multiplied by half the velocity, and to the product $\frac{1}{5}$th part be added for loss by cooling, &c., the sum, divided by 1480, gives the quantity of water in cubic feet per minute required for the boiler; and twenty-four times this quantity is necessary for injection. The diameter of the injection aperture should be one 36th part of the diameter of the cylinder, and that of the injection pipe one 9th part.

"In a single-acting engine, on Watt's principle, the capacity of the air-pump and condenser should each be $\frac{1}{8}$th of that of the cylinder, or their dimension should each be half the diameter and half the length of stroke of those of the cylinder. By multiplying the area of a section of the cylinder by half the velocity, adding $\frac{1}{10}$th for cooling, &c., and dividing the sum by the volume of the steam corresponding to its force in the boiler, the quotient is the quantity of water required for steam per minute. The quantity of injection water should be twenty-four times this quantity, and the diameter of the injection pipe one 36th part of that of the cylinder.

"In a double-acting engine the proportions of the air-pump, condenser, and cylinder should be the same as above; the quantity of water required for steam and injection double, and the proportions of the injection pipe and cylinder the same. At the ordinary pressure of two pounds per circular inch on the valve, in both engines, the divisor for the volume of steam is 1497. The proportions of the dimensions of boilers are commonly stated to be—for width, 1; for depth, 1·1; and for length, 2·5; otherwise, five square feet of surface of water is allowed for each horse power. Boulton and Watt allowed 25 cubic feet of space in the boiler for each horse power.

"*Effective pressure of steam in engines.*—Mr. Tredgold estimates the loss of motive force in the common atmospheric engine, due to the uncondensed steam (temp. 160°), to the force requisite to expel it and the air from the cylinder, to the friction of the piston and axes, and to the force required to open and close the valves, and raise the injection water, at ·49 of the atmospheric pressure; hence the effective pressure is only ·51 of this pressure, or 5·9 lbs. per circular inch. In the atmospheric engine, with a condenser, the loss of motive force due to the same causes, with the addition of the force requisite to work the air-pump, is only ·458 of the atmospheric pressure; hence the effective pressure is ·542 of this pressure, or 6·25 pounds per circular inch.

[To be continued.]

LONDON AND DOVER ENGINEERING EVIDENCE.

From the Evidence of George Walter, Esq.

[Continued from page 152.]

There is a part which is very narrow; what is the breadth of it there?—It is by the side of the railway; it is very narrow.

You are speaking of increasing this?—Not on that point, that is increased already 65 feet.

That is the depôt you say; you can add sufficient to have three trains throughout the whole line, can you?—We can.

How can you there?—This being the station it does not require it; it is 65 feet already.

It is sufficient for the present purpose?—Or future purposes, we never contemplate having stations there.

You have made it too wide at first?—No, but the traffic we thought might come.

It is in proportion to the rest of your railroad?—Yes.

Have you not had some accident on your railroad; some part broken down?—No, with the exception of the two arches which I just alluded to. In the frosty weather the Irish labourers were ordered to place some bricks, and they took away the shores; they were two end arches; they fell; the mortar was not dry.

Was there any weight on them?—I believe there was some weight at a distance that had been carried to the top to fill up between the spandrils.

How are you to get the money to make this alteration?—We can very easily get it.

Have you had a meeting of the directors on the subject?—No, it has not been thought necessary; for I conceive the railway, as it is now formed, is sufficient for all the traffic that may come on it for many years.

So that there has been no meeting of the directors on the subject?—No, it was not thought necessary.

Is it in contemplation to have a meeting?—When the necessity arises we should have a meeting, and of course order it to be done.

By the Committee.—When you say for many years, do you contemplate the junction of these other railways?—I do.

Do you think it is sufficient in its present state for the traffic the other railway will bring?—Yes, I am sure it is.

It is only two lines of road?—Yes.

That you think sufficient with reference to any increased traffic the others will bring on it?—Yes.

But in the event of it proving insufficient, you have the land sufficient to widen it to any extent, by any possibility that may be required?—Yes; I can conceive whatever traffic will be on that road that we can provide for it.

Suppose that necessity, contrary to your opinion, should arise, what time would it take to give an increased width to the railroad,

and to do all the necessary works to receive those?—I can conceive, having property in our possession, it could be widened in nine or ten months.

Would the traffic in the meantime be suspended?—No, it would not; it could be erected on the side of the railway while we were working the present road.

By Mr. Pollock.—Were you aware of the three proposed lines between London and Dover existing?—Only since the Gravesend Bill.

You are aware?—Yes.

Do they not all propose to join on to the Greenwich?—They all do.

Therefore of course if my learned friends think your railway would not do for us, it would not do for them?—Exactly.

The Greenwich Company are paid by a mileage toll on the railway?—Yes.

What is the maximum toll in your Act of Parliament; that is, you cannot take beyond a certain amount: the tolls are regulated in your Act of Parliament, are they not?—They are.

And there is a maximum toll prescribed in your Act of Parliament?—I believe there is.

As to the junction of the Croydon Railway with yours, that was a matter of arrangement when the Croydon passed their Bill last session?—Yes, it was.

They were authorised to come on your railway?—Yes.

Must any trains from Croydon come on your railway; will they not be subject to the tolls of your railway for travelling on it?—They will.

The tolls are regulated by your own Act of Parliament?—Yes; they are to pay one-third of the tolls.

Your proprietors are to be remunerated by the tolls to be received on your railway?—Yes.

After paying your outgoings?—Yes.

Is it not desirable for the proprietors of the Greenwich Railway that their railway should be as much used as possible?—Certainly.

Is it not their interest to consent that all the traffic from Brighton to Dover should come on their railway?—Certainly.

Will it not be an inducement to the Greenwich Railway to give every accommodation to that additional traffic?—Yes; every accommodation will be given.

You have been asked what arrangements have been made; would it not be prudent for your company to wait to see if this additional traffic is likely to come?—I conceive so.

If these long railways were to occupy several years, if the Act should pass, do you doubt but that your proprietors would take immediate measures for that necessary accommodation?—I am sure they would.

I understand. We all know the Croydon Railway Act passed last session, and you have a considerable quantity of ground here capable of being taken in your depôt?—We have.

You are aware, I take it for granted that you know, that the Croydon Railway Bill is now in Parliament?—I am.

Is the object of that Bill to enable them to increase the depôt there?—It is.

With the consent of your company?—Yes; which has been given.

Was not that Bill brought into Parliament in consequence of the expected additional traffic by the junction of the Croydon, and the ulterior views of other companies?—Yes.

With a view to the additional accommodation that would be required?—It was.

By the Committee.—When you say you think the present line of railway will be sufficient for many years, what do you contemplate at the expiration of many years?—I contemplate that it will take two or three years before the Croydon or the Brighton line will be finished, before they will get into active operation, so as to have a number of trains passing over it.

You do not consider it sufficient for the junction of any other railroad at the present moment?—Yes, I do; but should it become necessary in three or four years, or whenever the increased traffic takes place, the Greenwich Company would then be ready to double their lines.

Do you take the whole amount of tolls authorized by your Act? —We shall, I believe.

Do you now?—We do not at present; we only work two miles out of three miles and three quarters.

Your road is not completed?—It is not: it will be in about two months.

Have any persons a right to run carriages on your road, paying tolls?—They have, the same as all railroads.

I may start a carriage if I please, by payment of the tolls?—Yes.

When you speak with reference to the traffic along the Greenwich line, originally, when the project was formed, you had no great reference to the traffic of carriages laden with goods, but principally passengers?—The benefit to all railways is the passengers, not so much the heavy goods.

But the Greenwich Railway is peculiarly a passenger railway?—We contemplated carrying more passengers than heavy goods.

Then they are formed for the conveyance of passengers rather than the transit of goods?—I conceive it is the profitable part of the railway system *.

What is the thickness of the rails?—The weight is 50 lbs. to the yard.

Did you find any tremulous motion on the surface of the water in either case?—Not the least.

How far are your sleepers apart on the blocks?—About two feet between the chairs which hold the rails; they are fixed on the granite.

* Some questions were here put relative to experiments made with a glass full of water, put on the parapet walls and other places, for the purpose of showing that there was no vibration to affect the stability of the structure. Our opinion is that such proofs were not wanting, and if they were that the experiment was not well chosen for the object.—EDIT.

What is the weight of the rails?—50 lbs. to the yard.

If the public generally have a right to travel over this railroad, must not that be exercised under some regulation as to the time of starting?—It is specified in the Act, that all the carriages passing must be under the sanction and regulation of the engineer of the Greenwich Company.

Is there any clause or regulation in your Act by which any undue partiality on the part of that officer can be punished?—I believe there is a reference to magistrates on that point; I believe so.

And there is no vibration?—Yes, there is no vibration.

In your opinion, if those sidings or extensions of the railway were to be made, that might be a matter of arrangement, so as to be called the Croydon and Brighton part coming in junction with yours, and the expense is borne by them in any way as a matter of arrangement? —It is all subject to an arrangement.

You do not consider the Greenwich Company, of necessity, obliged to go to Parliament, because that it might be the act of either the joining of these companies?—Exactly so.

They have taken powers in their Act for four lines?—Yes, they have, for their stations, their booking-offices, and so on.

Could they lay another line without extending the arches?—It would be necessary to extend the arches to preserve the levels.

What is the width between the parapet walls and your clear?—About three feet.

What is the width of your rails that are laid?—About 4 feet 8½ inches.

What is the width from the centre?—4 feet 8½ inches; established by Act of Parliament.

That is in the centre between the rails?—Yes.

Then there is the width of the rails?—In the centre there is about 6 feet.

That is two 6's and 1 foot 8?—One 6, and two 4 feet 8½.

Then there are two 3 feet?—Yes, that is the clear.

How much is the clear inside?—22 feet.

What do your carriages overhang the rails as they go along; how much?—I think about 6 inches.

You are running your own carriages?—Yes.

No other than those belonging to the Company are now running? —No others.

In your rate of charge, do you charge a proportionate rate by Act of Parliament?—Not at present.

Not quite so much?—It is optional at present; it is under the mark.

It is under *pro ratâ* for the distance?—It is rather more; we only consider it an experiment.

Do you think yourself justified in making an increased charge *pro ratâ*?—Yes, I think so.

[The Witness withdrew.]

SCIENTIFIC AND MISCELLANEOUS MATTER.

Rain without Clouds.—It is stated by M. Arago, on the authority of M. Humboldt and Captain Beechy, that sometimes between the tropics rain will fall in a perfectly serene, pure, and cloudless atmosphere. The drops are not very thick, but unusually large, surpassing in size those of storms in our climates.

We have ourselves, in more than one instance, imagined we have witnessed a similar phenomenon in these regions. One morning in particular we remember an instance, at our present house, of seeing rain fall very sparingly when the atmosphere was quite still, and there was apparently no cloud near the zenith. Rain had fallen in the night or day before, and the sky possessed that brilliant transparency which sometimes follows showery weather. Struck with the phenomenon, we examined the sky overhead very attentively, and at length perceived very small—almost imperceptible—traces of nebulous matter. Had the sun been very high, we doubt whether this would not have escaped us altogether. May not the same have occurred in the places alluded to? The light being much stronger might have rendered that or a fainter cloud quite invisible.

These and many other phenomena we have desired our son, who usually spends several months in the year in the tropical climes, to pay particular attention to, and to inform us thereof.

Snow, when there has not been the slightest trace of a cloud except near the verge of the horizon, we have several times witnessed; but this is quite a different affair.

American Locomotive Engines.—A committee of the city and council of Baltimore have lately made a report on some experiments with an American locomotive engine they witnessed on the Baltimore and Ohio railroad, which it was our intention in a former Number to notice, but which we were obliged to omit for want of room.

Nothing would delight us more than to see the loco's, as they are briefly called, improved in any country. We are quite satisfied there is plenty of room. But our transatlantic brethren have travelled at too much of a railway speed in such round assertions as the following: "that the artisans of this country have produced a more perfect machine than has yet been manufactured in England." What have they proved? that they have constructed an engine of 8¼ tons, with coupled wheels, which would take 25¾ tons, including itself, up a plane rising 227 feet a mile, or on a level not 39¼ times its own weight? Why, we have had engines on the Liverpool line which have taken 44 times their own weight on a level, and therefore would take near 40 tons more than this boasted exploit.

Our good friends do not appear to us very well to understand the subject they are on. They say: "The capacity of a locomotive engine, when employed in heavy drafts, depends on three things: 1st, its weight, which gives it the adhesion on the rails that requisisite;

2nd, the capacity of the cylinders to *use the adhesion to its utmost limit*; 3rd, the ability of the boiler to supply the cylinders with steam equal to their capacity." An infant in locomotion knows the first of these things; but with regard to the second, if they mean cylinders which are always to furnish a pressure sufficient to employ the whole adhesion, we must beg to tell them it is impossible. When an engine is doing its best, or working uniformly, the bite or adhesion always exceeds the tractive force due to the then action of the cylinders. In fact the engine could not have a uniform velocity without it did. As to the third "thing," we confess it is to us quite unintelligible. The faster steam is supplied to the cylinders the better, and the greater the speed the engine will be able to attain; but it will not draw one ounce more weight. If the American artists have increased the generation of steam, they have made a valuable improvement; otherwise, adding to the diameter of the cylinders and length of the stroke appears to us to be rather a disadvantage than an advantage. Their cylinders are "12½ inches in diameter and 22 inches stroke, while the English engines rarely exceed 10 or 11 inches in diameter by 17 or 18 inches stroke."

In one thing they certainly appear to us to have improved much. They have 400 tubes through their boiler, instead of about 120; and "at the end of nine months' constant use the tubes of the Baltimore boiler have been found on examination as perfect as when they were inserted." This exactly confirms our suggestions published about twelve months ago. "If," said we, "the tubes could be still further diminished in diameter and increased in number, it would contribute much more to the steam-generating power of the engine; while I apprehend it would greatly lessen the burning out of these tubes, and consequently the excessive expense of repairs."

A powerful Machine.—We learn from Genoa that Dr. Giovanni Palmerine has just invented a new machine of iron, which, though of the utmost simplicity, will, by a motive-principle hitherto unknown, *act* with all the multiplied power of the theory of Archimedes, and at the same time with all the regularity of a steam-engine. It is only five yards and a half long, three yards broad, and three and a half yards high, and yet is of the enormous capacity of 1340-horse power!! WHAT NEXT?—*Birmingham Journal.*

RAILWAY NOTICES AND INTELLIGENCE.

PROGRESS OF RAILWAY WORKS.

London and Greenwich Railway.—This work is advancing rapidly, and there is every reason to believe that the line from London to Greenwich will be completed in August next. Nearly one thousand

arches are built, and about five thousand yards of rails are laid and fixed. We are glad to perceive that the bridge over the Ravensbourne has been commenced, and that the ground on the other side of that stream is in possession of the Company; so that the whole line to Greenwich must, in a very short space of time, be completed, and open to the public. The difficulties which the Company are said to have met with, in crossing the Ravensbourne creek, are, we are credibly informed, imaginary, and that in fact there has been no impediment whatever to the progress of the works, except at one time a temporary scarcity of bricks, which, however, is now no longer felt. We understand that all the bricks, stone, &c. required for this great work are now on the ground. Preparations are making for the opening of the *Arcade* under the London end of the Railway.

Manchester, Bolton and Bury Canal Navigation and Railway.—The proprietors of this company lately held their annual meeting at Hayward's Hotel, Bridge Street, Manchester. This railway is in an active state of forwardness, and will be open to traffic next spring. It appears that by other and new communications to be opened with the railway, and also with the canal of this company, a very great accession of income is expected beyond what was calculated when the concern was first undertaken. An agreement has been entered into with the Liverpool and Manchester Railway Company, to make a junction of the two lines at Salford. This will open a direct railway communication from places on the Bolton and Bury Railway to Liverpool, and offers to other railroads coming into Manchester from the eastward, a favourable channel for getting forward to the same place.

Preston and Wyre Railway.—The directors of this undertaking are giving some proof of their intention to carry this project into effect. A considerable portion of the land on the line between Burn Naze (now called Wyreton) and Kirkham has been conveyed to the Company, and a large quantity of iron rails are expected daily from Cardiff.

We also learn that great exertions are making at and near the terminus of this undertaking. A large quantity of stones have been brought into Wyre during the week, from Heysham and other places. for the purpose of the embankment from Burn Naze to the Warren; and that all necessary precautions have been adopted to guard against any delay in the further progress of the project.

Preston and Wigan Railway.—Sixteen hundred men are employed night and day on the railroad between Preston and Wigan.

Southampton Railway.—The inhabitants of the Channel Islands will be highly gratified to learn that the Southampton railroad is being completed with all possible despatch. There are no less than three hundred persons employed in the small space between Southampton and Winchester. It is expected that the whole line of road will be completed in the early part of the year 1838. If Messieurs

the Navigators will permit, the part to Kingston will be opened, it is expected, in about one year.

A great number of men are employed on the work between Northam and Portswood; an excellent foundation has been found beneath the mud land-section, and a great extent of brickwork is in course of erection.

Retardation of Railways by the High Price of Labour.—Owing to the great demand for labour the wages have risen considerably, and increased obstacles are thrown in the way of completing the lines which are in progress. The Birmingham, Southampton, and other lines, we are informed, are not proceeding with little more than half the rapidity they were. Of course this, with the great rise in iron and other things, must tell materially in the estimates, and tend much to retard that early benefit the country would otherwise derive from these undertakings.

Common labourers are offered on the London and Birmingham Railway, from fifteen to eighteen shillings per week, and masons four shillings and sixpence per day, but even at these wages the application for hands in many places has been unsuccessful.

RAILWAY NOTICES.

Panoramic View of the River Thames, exhibiting the Route and Terminus of the City Railway.—A lithographic engraving of the design of the City and Richmond Railway, after the original drawing by Charles John Blunt, Esq., has just been published, affording a clear and lucid view of the route of the entire Railway, from its commencement, at the Company's wharfs at Southwark bridge, to the termination of its branches at Richmond, and at the junction of the Birmingham and Great Western Railways at Holsden Green. In the design of this work we find the Railway is contemplated to be carried on arches from Southwark bridge, traversing Blackfriars road by means of a splendid arch of uniform architectural character with the Blackfriars bridge itself, whence it will proceed almost in a straight line to Nine Elms, where it meets its first junction, viz. the Southampton, the Brighton, the South Eastern, and South Western Railways, all of which terminate at this point. The continuation of these lines into the seat of business is effected by the City Railway. Having received, then, these three important trunks from the south-western coast of England, the Railway continues its single trunk to Battersea, and a little beyond the bridge divides into its two great branches, the direct leading through Barnes and Mortlake to Richmond, within a very few yards of the bridge, whence passengers can be conveyed to the City in twenty-five minutes, a journey that now occupies nearly two hours by means of stage-coaches. The second branch, which, in a commercial point of view, is the most important, goes to the Thames, across which it is carried by a viaduct to Chelsea, whence it is continued in part close to the Kensington-canal to Harlesdon-green, at the junction of the two most important Railways in

the kingdom—the Great Western, which connects Bristol and the intermediate towns with the metropolis, and the Birmingham, Manchester, and Liverpool Railway, which is destined to carry the manufactures and produce of all the great commercial towns and districts of the north. As a large portion of the goods conveyed by these railways will be for exportation, by means of the City trunk, they can be conveyed in a few minutes to the Company's wharf, without any change of the trains, thus saving all the expense, trouble, and what is no small consideration in a commercial country, the delay consequent upon the cartage at the terminus near Euston-square or Farringdon-street—a delay that would be generally as great as the whole time of conveyance of merchandise from the North to London. Nor does this appear to be the only advantage derivable from this branch of the City Railway, for the produce of the manufacturing towns destined for any of the places through which the Southampton, Brighton, or Dover Railways pass, need never be disturbed, but may be conveyed from one Railway to the other in the very trains which brought them from their place of starting. Thus goods that are dispatched from Birmingham, or Manchester and Liverpool, in the morning, may, by means of this connecting Railway, arrive in Brighton or Dover the same evening, a facility of communication that can be equally shared by passengers. No Railway Company, therefore, is likely to produce more benefit to commerce, and consequently greater advantage to those who embark their capital in the speculation.

Bath and Weymouth Railway.—The survey of the lines of railway intended to be made by this Company has been for some time in progress. The main line and branches between Bath and Frome are nearly finished, and it is expected that the whole will be completed by September. Stone blocks, which form a large expenditure in railway constructions, will be obtained very near the lines, and will in some places be found adjoining to the railway. The owners and occupiers of lands which will be intersected are in favour of the project, and the bill is expected to meet no opposition.

Bristol and Exeter Railway.—In about twenty-two months from the present time, it is expected this railway will be opened from Bristol to Taunton and from Exeter to Collumpton, leaving a distance of only 20 miles unfinished; and that the entire line will be completed within three years and a half. Mr. Brunel has surveyed the country for a line connecting the Coalpit-Heath Railway with that of Cheltenham and Swindon, near Stroud. This projected line, therefore, of only 20 miles in length, is now all that remains to complete the connexion between Exeter, through Bristol, Gloucester, and Birmingham, with Liverpool, Manchester, Leeds, and Hull. Mr. Brunel is also engaged in surveying the country west of Exeter, with a view to a railway from that city to Plymouth and Devonport, which there can be no doubt, when completed, must considerably augment the resources of every other connected with it.

The London and Cambridge Railway is to be commenced forthwith. In the first year it is expected that twelve miles will be completed and thrown open. The great cuttings at Audley End will occupy 120 men during eighteen months.—*Globe, July* 13.

Cheltenham and Tring Railway.—The projected line by way of Winchcomb to Andoversford has been found so fraught with engineering difficulties as to be impracticable.

The Deptford Pier.—The first iron pile of the Deptford Pier was driven on Monday in the presence of all the Directors and their friends. It is considered that the whole will be completed in about eight months.

Durham Junction Railway.—The bridge now erecting across the river Wear by the Durham Junction Railway Company is in a state of great forwardness, and when finished will present a very handsome appearance. The Company's works on this line, which will connect the Tyne with the Durham Coal-field, are proceeding very rapidly.

The Doncaster, North Midland, and Goole Railway.—A prospectus has just appeared of a railway under the above name. The object is stated to be the extension of the North Midland and Sheffield and Rotherham railways, by way of Doncaster, down the valley of the river Don, to the port of Goole, so as to give the manufacturing towns of the midland counties an expeditious and direct communication with the Humber. A principal object of the projectors is also to bring the limestone of Derbyshire within reach of the agriculturists east of the Trent; and to convey forward to the outport the coal brought from the valley of the river Rother, &c. The town of Doncaster will be on the line, and is expected to furnish considerable traffic in grain. The length of the projected line is 28 miles, and an Act will be applied for next Session.

London and Dover Railway.—Since the determination arrived at by the London and Dover Railway Company of reorganising their plans, and making Ramsgate and Margate their places of terminus, the most anxious disposition has been shown by the public to forward so desirable an undertaking. We trust that the only difficulty which lay in the way, namely, the passage through Greenwich Park, will no longer be an obstacle.

Evil of Railroads.—A *Yankee* canal stockholder's argument in opposition to railways:—"He" (the canal stockholder) "saw what would be the effect of it (the railroad system); it would set all the world a-gadding. Twenty miles an hour, sir! why, you will not be able to keep an apprentice-boy at work; every Sabbath evening he must make a trip to Ohio to spend the Sabbath with his sweetheart. Grave, plodding citizens will be flying about like comets. All local attachments must be at an end. It will encourage flightiness of intellect. Veracious people will turn into the most immeasurable liars; all their conceptions will be exaggerated by their magnificent notions

of distance. 'Only a hundred miles off! Tut, nonsense, I'll step across, madam, and bring your fan!' 'Pray, sir, will you dine with me today, at my little box at Alleghany?' Why, indeed, I don't know—I shall be in town till twelve. Well, I shall be there, but you must let me off in time for the theatre.' And then, sir, there will be barrels of pork, and cargoes of flour, and chaldrons of coals, and even lead and whiskey, and such like sober things, that have always been used to sober travelling, whisking along like a set of sky-rockets! It will upset all the gravity of the nation. If two gentlemen have an affair of honour, they have only to steal off to the Rocky Mountains, and there no jurisdiction can touch them. And then, sir, think of flying for debt: a set of bailiffs, mounted on bomb-shells, would not overtake an absconded debtor, only give him a fair start. Upon the whole, sir, it is a pestilential, topsy-turvy, harum-scarum whirligig. Give me the old, solemn, straightforward, regular Dutch canal, three miles an hour for expresses, and two for jog and trot journeys, with a yoke of oxen for a heavy hold! I go for beasts of burthen; it is more primitive and scriptural, and suits a moral and religious people better. None of your hop-skip-and-jump whimsies for me."—*New York Gazette.*

Gloucester and Birmingham Railway.—Every step is taking by the Company to commence the work as early as possible, it being their anxious desire to complete the line with the least possible delay.

Glasgow, Paisley, and Greenock Railway.—The Company are proceeding with their preliminary operations with the utmost zeal and spirit.

Irish and Scotch Railways.—Railways increase in all directions. The Ulster Railway Company is going on under the most auspicious circumstances. The report made last Saturday by the Provisional Committee stated 11,874*l.* to have been received as deposits, and the expenses hitherto incurred for surveys, parliamentary charges, and all other matters necessary to forward the undertaking amounted but to 4555*l.*

Irish Railways.—A meeting of noblemen and gentlemen connected with Ireland, was lately held at the Thatched House Tavern, for the purpose of concerting measures with Government for the establishment of a general Board or Committee, to whom all plans for Irish railways might be referred before Bills to carry them into effect were presented to Parliament, in order thereby to prevent litigation, and the clashing of different projects. It was also proposed that the Board should examine the southern and western coasts of Ireland, with a view to the selection of the best railway lines. Resolutions to this effect were agreed to; but the Dublin and Drogheda Railway Bill, now in progress, is not to be affected by them. Among the chief persons who attended this meeting were the Duke of Leinster (who presided), the Marquis of Downshire, the Marquis of Westmeath, Lord Charlemont, Mr. O'Connell, Mr. G. A. Hamilton, Dr. Lefroy, and Lord Clonmell.

Railways in Ireland.—The survey of the Great General Irish Railway (Grand Junction) connecting Dublin with Sligo, Galway, &c., is proceeding with unexampled rapidity. The line selected for this undertaking is peculiarly adapted for railway construction, presenting a continuation of levels unequalled in Ireland.

Liverpool and Manchester Railway.—The new tunnel running beneath the town and extending almost from the Wavertree Road to Lime Street, is one of the greatest works ever executed in this neighbourhood. It will bring the Liverpool and Manchester Railway and the Liverpool and London Railway into the heart of the town. The roof of the remarkably handsome shed erected at the mouth of the tunnel is one of the largest roofs of the kind in Europe, being considerably larger than that of Westminster Hall. The stone front of the building in Lime Street is massy, extensive, and when finished, will, we hope, be handsome and ornamental.—*Liverpool Times.*

Newcastle and Carlisle Railway.—That portion of this railway just opened from Carlisle to Greenhead, about 20 miles, passes through a highly picturesque country, and the works are in several cases on a most magnificent scale. The viaducts at Wetheral, Corby, and the river Gelt, may rank among the most important engineering works yet executed; and the cutting at the Cowran Hills, by the vastness of the excavations, and the beauty of the adjacent scenery, cannot fail to create a pleasing surprise in every spectator.

Padstow and Falmouth Railway.—A public meeting has been held at the Guildhall, Callington, to consider the best means of carrying this projected undertaking, and also the breakwater at Padstow, into effect; and several spirited resolutions were passed, expressive of the determination of the company to use every means in their power to accomplish their design.

Projected Railway.—A general meeting was held at Hexham lately, to take into consideration the formation of a railway, up the North Tyne and Reedwater, through the Carter Mountain into Scotland, and thence to Edinburgh and Glasgow. A series of resolutions was moved in furtherance of the measure which were all carried unanimously.

Railway Tolls.—A bill was brought into Parliament by Mr. Morrison and Mr. Gisbourne, for the revision of all tolls levied on railways under an Act passed in the present or any subsequent Session, but has been defeated. The provisions of this bill did not extend to tolls granted for a term of years. It proposed to enact that all Railway Companies should make a yearly return of their accounts to the Board of Trade, and the Board of Trade to be empowered to make orders as to the form and matter of the same.

Swaledale and Wensleydale Railway.—We understand that this railway is to extend from the village of Croft to the town of Richmond, pursuing the river Swale for nearly two miles, and immediately passing the splendid ruins of Eastby Abbey; and that at

a meeting of friends to the undertaking the line was highly approved of, and shares to the amount of 5000*l*. were then applied for.

Tyne, Edinburgh and Glasgow Railway.—That a railway communication will be eventually completed from Newcastle to Edinburgh does not admit of a question. The selection of the best line of road is, however, matter of some difficulty. The projectors of the Great North of England Railway are, we believe, in favour of the route by the east coast, to form a junction at Berwick with the projected railway from that town to Edinburgh, by way of Haddington and Dunbar. An opinion prevails in some influential quarters that this would not be the most feasible or profitable line of road; and a provisional committee was formed sometime ago, when it was resolved to instruct Mr. Joshua Richardson, civil engineer, to make a survey for a railway, to be called "The Tyne, Edinburgh, and Glasgow Railway", to pass nearly through the counties of Northumberland and Roxburghshire. By Mr. Richardson's first report to the provisional committee, he proposes to take the Newcastle and Carlisle Railway as a portion of the general scheme, and to branch off at Warden, near Hexham. The distances of the new line of road are thus computed: from Warden to Melrose, 60 miles; from Melrose to Edinburgh, 30 miles; and from Melrose by Peebles and Lanark to Glasgow, 69 miles:—making the total length of the proposed railway 159 miles. One of the most prominent advantages of the proposed line is, that it will go through the heart of a splendid country instead of running along the side of it, and thus afford great facilities for the formation of branch railways to the right and left. The distance by the proposed route will also be considerably shorter than by the east or west coasts.

A party of engineers arrived at Newcastle from London a few days since, and immediately commenced making surveys for the great National Railway between London and Edinburgh.

Whitby and Pickering Railway.—We are gratified to learn that this railway, the opening of which was lately announced, has already conferred important benefits on the towns and neighbourhood through which it passes, in the impetus it has given to traffic. Every possible accommodation in the way of conveyance has been provided for the public, in the certainty of a remunerating patronage and support.

FOREIGN RAILROADS.

Italian Railway.—Among the railroads projected by the Company, the chief office of which is at Rome, is one from Naples to Otranto, a distance of 180 miles, which will be divided into three stages, and will have branches to towns of lesser importance. It is said that one is also to be carried from Naples to Reggio. A very great number of the shares of the Company have been taken by the English.—*French Paper.*

St. Petersburg, June 22.—The St. Petersburg Gazette announces that the whole of the rails for the iron railroad to Zarskojeselo have been contracted for in England, with the condition to deliver the whole this summer. We can add, from good authority, that there is now nothing to hinder the completion of this work in the autumn of this year.

A magnificent Project.—The prospect of the independence of the Texas has already given rise in New Orleans to a splendid design, which, if carried out, will create quite a new era in the history of a part of the commerce of this country. It is well know that steamboats of 500 or 600 tons can ascend the Red River as high as Natchiloches; and it is now proposed, in a New Orleans paper, that a railroad should be constructed from that point, through a gorge in the Southern Rocky Mountains, and thence to the Gulf of California. Such a work would give to New Orleans access to the East Indian, Peruvian, and Chilian trade, which would enable her to set competition at defiance. It appears to us, however, that it is not by the Red River, but by the Rio Grande, that this communication must be effected, if at all. This last river has a course estimated at from 1500 to 1700 miles in extent, and can be ascended by steam-boats of light burthen nearly 700 miles, which will be within an inconsiderable distance of the Colorado of the West, a river that empties itself into the Gulf of California. It is probable that a portage railroad connecting these two rivers need not be of greater length than 200 miles. If this communication were opened, the route to India and to the western coast of South America would be shortened more than one half.—*Baltimore Chronicle.*

Railroad across the Isthmus of Suez.—Eleven cargoes of iron rails for the above railway have arrived at Cairo. The work will be commenced immediately.

Miles of Railroad in the United States.—It is computed that they already amount to 3000. If a double track is made to each, they will require 714,000 tons of iron for rails; which if paid to Great Britain during the next seven years will amount to *fifty millions of dollars.*

Railroad from Prague to Pilsen.—"This important undertaking, when completed, will extend about eighty English miles. It was begun in 1825, under the auspices of the Austrian government. Its formation and management were committed to the Chevalier Von Gerstner, who spent some weeks at Darlington, a few years ago, to make himself master of our English system of road-making. During the first two years, namely from August 1825 to December 1827, the Chevalier was enabled, in the course of forty and a half English miles, to cut no less than 696,464 cubic yards, and to construct 807,844 cubic yards of embankments, besides laying the way with malleable rails. He erected also, during those two years, seventy-three bridges, from three to eighteen yards each, with one hundred and thirty-three culverts; and he also made two hundred and thirty-

six wagons. The whole cost of the railway, during that period, amounted only to about £75,200 sterling."

What a contrast to the way in which these things are done in England, where it would cost the whole amount on engineers, lawyers, and M.P.s before an undertaking of half the importance could be begun!—*Literary Gazette.*

PARLIAMENTARY PROCEEDINGS ON RAILWAYS.

HOUSE OF COMMONS.

June 28th. Petitions in favour of Stevenson's Brighton Railroad were presented from places in Sussex, viz. Worthing, Steyning, Shoreham, Horsham, and several other places; also from Dorking and Leatherhead. A Petition from Lewes, by 760 persons, in favour of Sir John Rennie's line. A Petition from the inhabitants of Brunswick-square, Brighton, against Stevenson's line. Sir J. Beckett, referring to the amendments made by the Lords in the Midland Counties Railway Bill, said that one of those amendments related to the imposition of certain tolls. It appeared to him objectionable on public grounds, without going at all into the question of privilege. He accordingly moved "that the house do disagree with the said amendment." The motion was put and agreed to, and a committee was then appointed to draw up reasons for the house disagreeing to the said amendment, which reasons were to be communicated to the Lords at a conference. A Petition from the owners and occupiers of houses in the Commercial-road against the Blackwall Commercial Railway, and a similar Petition from the owners of omnibuses and coaches plying on that road. (*A laugh.*) A Petition from Harwich in favour of the South-West Durham Railway Bill. A Petition, signed by 7,300 persons, praying the house not to sanction either of the lines of railroad to Brighton projected with tunnels, on the ground that they were attended with considerable danger. Mr. E. Tennant observed that Mr. Cundy's line had been unfairly treated. A Petition in favour of Mr. Cundy's line laid upon the table. On the order of the day being read for the further consideration of the Report on the London and Brighton Railway, which recommends "Stevenson's line," Mr. Alsager moved "that the further consideration of this Report be entertained this day six months." After a long discussion, the house divided, when there appeared for the amendment 61, against it 101; majority for the original motion 40.—June 29th. The third reading of the London and Brighton (Stevenson's line) moved, when Capt. Alsager and Mr. Curtis expressed their regret that so little attention was paid to the petitions which had come from Brighton, so strongly expressive of the feelings of the inhabitants of that town, against this bill and in favour of Sir John Rennie's line. The Bill was then read a third time and passed. South Durham Railway Bill read a third time and passed. London and Blackwall Commercial

Railway Bill read a third time and passed.—July 7th. A Petition from 800 inhabitants of Lambeth against the Durham South-West Junction Railway.—July 8th. The Report on the Dublin and Drogheda Railway considered and agreed to, and the bill to be read a third time on Monday next.—July 11th. The Dublin and Drogheda Railway Bill read a third time and passed. Sir Robert Peel presented a Petition from the proprietors of shares in the Birmingham and Derby Junction Railway against the Bill called the Periodical Revision of Tolls Bill. It appeared to him to be of great importance that the hon. gentleman who had brought in that bill should without delay declare whether it was his intention to pass it, if possible, this session. Such a bill should not be postponed from day to day, and kept up in the shape of a menace against railway speculations. (*Hear.*) The effect was, that many were deterred from purchasing shares in railways; that the transfer of shares in most of them had come to a stand-still; and that, in fact, this branch of commercial enterprize was injured and almost paralysed. In the case of the present petitioners, though they had obtained their act of parliament giving them a vested interest in their undertaking, they had altogether suspended their proceedings until they ascertained whether that house would be persuaded by the hon. member for Ipswich to pass an *ex post facto* law taking away vested rights conferred upon them by a previous act of parliament, and giving them in return a lease of 21 years, or something of the sort. Should such a second act pass, and this railway be made subject to it, it probably never would be commenced. He most decidedly objected to the principle of the bill. The Petition was ordered to lie on the table.—July 12. Mr. Sandford presented a Petition from the shareholders in the Bristol and Exeter Railway Company against the Railways Revision of Tolls Bill. The order of the day for the second reading of the Railway Revision of Tolls Bill was read, and the Bill ordered to be read a second time that day six months.—July 14th. Sir C. Burrell brought a charge against Mr. Cundy, the engineer of one of the Brighton lines of Railway, for a breach of privilege, for having made assertions against him (Sir C. Burrell), and using his name in a most reprehensible way. Mr. Cundy had stated as a reason why he (Sir C. Burrell) had voted for Stevenson's line was his having had 15,000*l.* awarded to him as compensation for land required for the railway, which land was not worth so many hundred pounds. Such an imputation was totally untrue. Capt. Pechell believed "that such a trumpery case had never before been brought before the House." Mr. Wynn, however, was of opinion that charges of so grave a nature should not pass unnoticed; and, on the motion of that right hon. gentleman, it was ordered that Mr. Nicholas Wilcox Cundy be summoned before the bar of the House on Monday next.—July 18. The House was occupied for a considerable time with the investigation of Sir C. Burrell's complaint against Mr. Cundy, who made his appearance at the bar of the House. It appeared, however, that Mr. Cundy had not made the statements complained of as matters of fact of which he was himself cognisant,

as he had seen them in a Brighton paper, but that he had mentioned them merely as reports that were generally circulated. Under these circumstances, it was not considered worth while to take any further steps in the affair. A long discussion occupied the time of the house, which was terminated by Lord John Russel moving, as an amendment, that the House should proceed with the order of the day. On this motion a division took place: for the motion 114, against it 56; majority for the order of the day 58.

HOUSE OF LORDS.

June 28th. The Duke of Richmond laid upon the table the First Report of the Committee on Railroads. On moving that it be printed, a discussion took place, when the Report was ordered to be printed. —June 30. The Brighton and London Railway Bill (Stevenson's line) read a first time.—July 4th. The Royal assent (by commission) to the Manchester and Leeds Railway Bill, the Dundee and Newstyle Railway Bill, the Great North of England Railway Bill, the North Midland Railway Bill, the London Grand Junction Railway Bill, the Hayle Railway Bill, the London and Cambridge Railway Bill, the Sheffield and Rotherham Railway Bill, the London and Croydon Railway Bill, and the Thames Haven Railway and Dock Bill. A Petition from between 5,000 and 6,000 inhabitants of Brighton, praying to be heard by counsel against Stevenson's line. According to the statement of the petitioners, the consequences of adopting that line would be extremely injurious to the public in every form, while it would altogether prevent the construction of a second line, although it should afterwards be proved to be superior. A Petition from certain other inhabitants of Brighton in favour of it. Another Petition from Brighton against Stevenson's line. Another, signed by 8,000 most respectable inhabitants of Brighton, praying their Lordships, as they regarded the public safety, health, and comfort, to reject all lines with tunnels, and sanction that which should be constructed without a tunnel. Two more Petitions, from two places in Sussex, against Stevenson's line. A Petition from Brighton in favour of Cundy's line. The Brighton Railway Bill (Stevenson's) read a second time, and to be committed on Monday next.—July 5th. Two Petitions from Croydon and Cuckfield, Sussex, against Stevenson's Brighton Railway Bill. A Petition from Bermondsey in favour of the Durham South-West Junction Railway.—July 7th. A Petition from Brighton against Stevenson's line. Petitions from Leatherhead, Horsham, Arundel, Steyning, Shoreham, Littlehampton, and Worthing in favour of the Brighton line.—July 11. A Petition from the Dean and Chapter of Durham against, and one from a place in Durham in favour of, the South Durham Railway Bill. A Petition from Weir in favour of this Bill. Against the second reading of it 51 to 19, or 32 majority.—July 12. A Petition from the Trustees of the Commercial Road, praying for compensation in the event of the Blackwall Railway Bill passing, and praying that the Bill might be recommitted.

PRICES OF RAILWAY SHARES.

Those finished are marked (1); in progress (2); which have their bills but are not begun (3); in Parliament (4); not in Parliament (5).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum Paid.	Closing Prices of Shares in London Markets on								
					June.	July.							
					28.	1.	5.	8.	12.	15.	19.	22.	26.
			£.	£.									
15,000	....	Altona and Lubeck	20	½	....	....	....	....	....	....	....	....	½
2,500	....	(3) Aylesbury	20	1	....	....	....	....	....	1½	....	1	
		(3) erby	....	5	....	8	7½	7	6½	5¾	4½	4⅞	7½
9,500	....	(3) loucester	....	5	....	7	6½	6½	6	5½	4	5½	5½
7,500	....	(3) Birmingham, Bristol, and Thames Junction	20	1	....	....	1	1	⅞	½			
15,000	....	(3) Bristol and Exeter	100	2½	4½	....	....	....	4½	3½	....	2⅞	2½
660	....	Calcutta and Saugur	50	2	1½	1	....	1½	....	....	1	1	
350	....	Cheltenham	100										
7,500	....	(3) Cheltenham and Great Western	100	2½	4	....	....	....	2½	2	....	1	1½
14,000	....	(5) Cheltenham, Oxford, and Tring	100	5	....	3½	....	....	....	3	3½	3½	3½
2,000	....	(2) Clarence	100	100	....	....	46						
12,000	....	(4) Commercial Blackwall	50	2	2½	2½	2½	2¾	2½	2½	2	2½	2
8,000	....	(5) Dublin and Kilkenny	100	2½	2½	2½	....	2½					
7,500	....	(4) Durham South-West Junction	20	3									
37,600	....	(3) Eastern Counties	25	1	1½	1½	1	⅞	1½	⅞	⅞	1	⅞
		Edinburgh and Dunbar	....	2									
8,000	....	(4) Edinburgh, Leith, and Newhaven	20	1	....	....	1½	....	....	1½			
13,000	....	(5) Edinburgh and Glasgow	50	2	....	5							
2,500	19s.	Forest of Dean	50										

800	....		Durham Junction	100	10									
2,800	....	(4)	Glasgow and Falkirk Junction ..	50	3									
		(2)	Grand Junction	100	40									
		(3)	Great North of England........	....	2	....	....	....	....	....	....	1		
		(5)	Great Northern	100	2	⅝	....	....	....	....	....	....	⅝	
25,000	....	(2)	Great Western	100	20	44½	....	44	42½	37	33½	30	37	37
2,000	....	(2)	Hartlepool	100	100	....	6							
2,100	....	(4)	Hull and Selby	50	5	7	....	....	....	....	....	....	4½	4½
10,000	....	(3)	Leeds and Manchester	100	5	22½	22	21½	21½	21	21	18½	20	23
7,000	....	(1)	Leeds and Selby	100										
2,000	....	(1)	Leicester and Swanington	50	50									
5,100	10l. per c.	(1)	Liverpool and Manchester	100	100									
			Ditto, ¼ shares	25	25									
10,000	....	(4)	London and Brighton (Stevenson's)	100	5	17½	17	15½	14½	12	12	8½	11¼	13
45,000	....	(5)	——————— (Gibbs)	20	1	⅞								
16,000	....	(5)	——————— (Rennie) ...	50	2	1	⅞	1	1	1	1	¾	¾	⅜
8,000	....	(5)	——————— (Cundy)....	100	2	1⅛	....	1	....	1	1	⅞	⅞	⅞
12,000	....		London and Blackwall	50	3	....	3	3¼	3¼	3	3⅛	3	....	2⅞
		(5)	London and Dover	50	1	....	¾	....	....	⅝	½			
30,000	....	(5)	London and Gravesend	20	1	⅝	¾							
20,000	3l. per c.	(2)	London and Greenwich	20	20	25½	25¼	25¾	25¾	26¼	25	24¼	24	24¼
			Ditto, Bonds.		....									
25,000	....	(2)	London and Birmingham	100	60	....	132	132	....	130	....	120	120	127
20,000	....	(2)	London and Southampton	50	20	25½	....	....	....	....	21	19	21	22
7,000	....	(3)	London and Croydon	20	5	5½	....	5⅝	10¾	10½	....	9⅛	9	
12,000	....	(3)	London Grand Junction........	50	2	2½	2¼	2¼	2⅜	2¾	2⅛	2	1⅞	2
1,000	....	(5)	Manchester and Oldham	100	3									
10,000	....	(5)	Manchester South Union	100	2	4¼	4½							

PRICES OF RAILWAY SHARES (Continued).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum Paid.	Closing Prices of Shares in London Markets on June 28.	July 1.	5.	8.	12.	15.	19.	22.	26.	
			£.	£.										
		(3) Midland Counties	50	5	....	6½	....	....	....	5½	3½	3½		
		(5) Margate and Ramsgate	....	2	....	....	....	....	....	1½				
		(3) North Midland	....	5	11	10	10	9	8½	7¾	6	7	8½	
		(5) Northern and Eastern	100	3	3½	3	2½	2½	2½	1½	2	1½	1½	
2,500	....	(2) Preston and Wigan	....	20										
2,600	....	(2) Preston and Wyre	50	3										
4,000	....	(3) Sheffield and Rotherham	25	3½	....	4½								
1,000	6l. per c.	(1) Stockton and Darlington	100											
1,500	....	(2) Stanhope and Tyne	100	100	105									
3,000	....	(5) South Durham	50	2½	....	2								
28,000	....	(3) South-Eastern	....	2	4½	4½	....	4½	4	3½	2½	3½	4½	
		(5) South Midland	50	1	1	⅞	....	....	....	¾				
40,000	....	(5) South-Western	50	1	¾	....	⅞	¾	....	¾	....	....	¾	
9,000	....	(3) Thames Haven	50	2½	....	....	1⅞	1½	....	1½	1½	1½	1	
6,600	....	(5) Victoria	25	1	....	¾	....	....	⅞	⅞	....	½	½	
		(1) Warrington and Newton	100											
6,000	....	(4) York and North Midland	50	1	....	....	....	2½	....	1½	....	1	1½	

The above, as we [illegible] closing prices of the day. They are the prices at the last business transactions. But it is to be understood that ther[illegible] rence of ¼ in the Stock Exchange between the prices a person can sell at and those he can buy at, the former being less than the latter. The prices obviously include the sum paid for the Share; and therefore the difference between them and the price paid on the Share is the premium or discount of the Share. Where there are blanks no business was done. We have carefully corrected the list of the Number of Shares wherever we could; but should any errors be left we shall immediately correct them when pointed out.

THE

RAILWAY MAGAZINE;

AND

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MATHEMATICAL LAWS OF RAILWAY TRANSIT.

By the Editor.

[Continued from p. 209.]

On the Generation of Velocities.

We have already shown how to find the velocity due to any given load wherever full steam can be applied; or rather the influence of load and inclination on the velocity, a unit of the engine's performance on a level being given. This unit, that is the maximum velocity the engine can maintain on a level with a specific load, or the maximum load at a specific velocity, which is absolutely necessary to be known. Besides, it gives greater simplicity to the future investigations, and divests the subject of a formidable horde of mathematical symbols calculated to confuse rather than to elucidate.

When the whole steam is turned upon an engine at rest, the piston, valves, &c. being all tight, the pressure shortly becomes exceedingly powerful; and if the wheels have not sufficient bite to move the load, they rapidly turn round, slipping on the rails. But if the bite of the working wheels be in excess of the force of traction, and the valve be loaded just enough to employ the whole bite, the superabundant steam will escape, and a gradually increasing motion ensue. As this motion increases so does the consumption of steam which causes it. Of course the steam blown away as gradually decreases. At length the blowing off ceases. Up to this point the whole bite of the wheels has evidently been called into operation, and the train has been urged forward by a force equal to the bite of the working wheels, minus the traction of the whole train; that is, by a steady uniform force.

At the point we have now reached the effective propulsion of the steam just equals the bite.

After leaving this point the velocity still goes on encreasing, because the bite of the wheels is necessarily in excess of the force of traction; but the blowing off has ceased, and the effective propulsion of the steam grows every moment less and less in consequence of the encreased consumption, supposing the intensity of the fire to continue unvaried. In time the effective force of the steam diminishes to an equality with the force of traction, and then, all other things being the same, the train moves uniformly forward.

These are the data from which I shall endeavour to compute the generation of velocity. They evidently furnish two distinct cases—one in which the force is uniform, and the other in which it is varying. Our writers on locomotives have not, as far as I am aware, touched on this distinction: indeed I have not met with any of their theorems on the subject. I do not of course here include the mathematical—if we dare disgrace the term with such an application—abortions of one or two individuals as contemptibly ignorant of science as the poor creature who edits the work they write in.

Employing the same letters in the same sense in which we have p. 161, the effective force of the steam from starting to the point where it equals the bite is bw, the amount of the bite. But to have the propulsive force we must diminish this by the force of traction tW of the whole train. Multiplying the difference by $g = 32\frac{1}{6}$, the force of gravity, and dividing by W, we have $g(\frac{bw}{W} - t)$, the accelerating force. Therefore, substituting this quantity for F in the well-known dynamical theorem $Fdx = vdv$, in which x is the distance run, and v the velocity corresponding, we shall have, by integration,

$$v^2 = 2gx\left(\frac{bw}{W} - t\right) \quad \ldots \quad (7).$$

Here no condition exists by which we can determine v or x, and at present they remain indeterminate.

Now, when the force begins to vary, that is, after passing the point to which the theorem just found extends, the fire being constant, and the whole of the steam employed, its effective force is inversely as the velocity. For, by the conclusion arrived at, p. 203, all other things alike the load is inversely as the velocity, and the force of traction which

the steam has to balance under such circumstances is as the load. Therefore the force of steam itself is inversely as the velocity. Hence, if v express the velocity at the before-mentioned point, where the bite and effective force of the steam are equal, the effective propulsion at any subsequent point is $\frac{bw\mathrm{v}}{v}$. Consequently,

$$g\left(\frac{bw\mathrm{v}}{\mathrm{W}v} - t\right) \ldots . (8),$$

is the accelerative force of the train.

When the train acquires its maximum and uniform velocity, this force must obviously be made $=0$, the force of the steam being then equal to the force of traction. Hence, if V be the uniform velocity, $\mathrm{v} = \frac{t\mathrm{W}}{bw} V = cV$, suppose.

We can now fix the value of X in (7), the so often cited limit or distance due to the first datum when the force is uniform; for

$$c^2 V^2 = \mathrm{v}^2 = 2gt\mathrm{X}\left(\frac{1}{c} - 1\right).$$

Substituting for the value of v in (8), and then putting this expression for F in the dynamical theorem before used, we have

$$gt\,\frac{V - v}{v}\,dx = vdv,$$

for the differential equation of motion. These quantities, g, V, v, x, are from the known principles of the equation in feet, and a second is the unit of time. To change them into miles, with an hour for the unit of time, we must change V, v, g, respectively, into $\frac{22V}{15}$, $\frac{22v}{15}$, $\frac{22\mathrm{G}}{15}$, and x into $5280x$, which will give

$$3600\mathrm{G}t\,\frac{\mathrm{V} - v}{v}\,dx = vdv,$$

where $\mathrm{G} = 21{\cdot}93$. The same transformations must likewise be made in (7), putting $a = 3600\mathrm{G}t = 281{\cdot}94$, when $t = \frac{1}{280}$.

If we integrate our differential equation from $x = \mathrm{X}$, and $v = \mathrm{v} = cV$, we shall obtain

$$\left.\begin{aligned} &a(x - \mathrm{X}) = V^2 \log.\frac{(1 - c)V}{V - v} + (cV - v)V + \frac{c^2V^2 - v^2}{2} \\ &\text{to which, adding } a\mathrm{X} = \frac{c^3V^2}{2(1 - c)} \end{aligned}\right\} \ldots . (9);$$

And we shall have the value of x, or distance run from the origin of motion to acquire the velocity v, the value of V, being previously assigned.

Observutions.

The first thing which strikes us in this result is, that the logarithmic part becomes infinite when $v=V$; that is, that it would take an infinite distance to acquire the maximum or uniform velocity. We may have anticipated this from the extremely slow manner in which the accelerative force necessarily diminishes when the velocity comes near its limit.

Hence, then, it is impossible for an engine ever to do its greatest duty on any line of railway; or, in other words, that it never can impart to any load on a level, starting from an inferior velocity, the velocity it would be capable of maintaining. Consequently the engine is always, under such circumstances, working to a disadvantage, and straining itself more than it would do to keep the load at a higher velocity, or at that which it could just maintain. The propriety, therefore, of so laying out that all departures from the termini should be down a descent, which I long since insisted on, has here another confirmation.

I am glad to find, by the engineering evidences before Parliament, that since I first published my ideas on this subject, they have had the effect of drawing the attention of engineers to this important principle in the construction of their lines. Engineers have not, however, as far as I can discover, advanced the least beyond the general views that I had given. Neither the degree or length of the gradient, nor any rules whatever beyond this vague one of having the departing plane descending, seems to have occurred to them. I shall now, therefore, make a few observations, which I hope will have the effect of fixing the matter within more specific limits.

On the Construction of Termini Planes.

Some imagine that mathematical investigations to such clumsy bodies as locomotive engines cannot be applied, and are a waste of time. If they are applied with a view to coincidences, as nice as in the heavenly bodies, they certainly would end in disappointment; but as far as regards limits within which the experiments can be made, there can be no question of the agreement if all the circumstances are taken into account. For instance; it was long supposed the theo-

rem I had given for computing the velocities up and down different inclines did not represent the performance of engines. But what was the fact? The whole difference, enormous as it appeared, was shown to arise from a body which engineers never dream of taking into account, namely, the resistance of the atmosphere. This being allowed, for the accordance was much closer than we had any right to expect; so it will be found in all other cases, where the investigations are conducted with skill and judgment.

If we suppose the steam to be so regulated that the engine shall every moment do the work of the road, and no more, then, setting aside the resistance of the atmosphere, the train will evidently obey precisely the same laws as a body sliding up and down the planes devoid of friction; that is, the laws of its motion will be perfectly mathematical. Now this mathematical state can nearly be attained about the beginning of the motion. For we can calculate very nearly the pressure on the piston wanted to overcome the friction of the road and machinery on a level; and provided there is no throttling of the steam in its passage to the cylinders, we can, by a valve properly loaded, always insure this pressure, if the velocity is not too high. Presuming this done, if a line, perpendicular to the horizon, be drawn from the starting point of the train, and another, parallel to the horizon, be conceived to be carried from the moving train to meet it, it is capable of mathematical demonstration, that if the starting velocities were the same, the train would have at any point in the plane the same velocity as a body would have at the corresponding point in the perpendicular supposing it left to the action of gravity in that line. Therefore the calculation of the velocity of the train would be reduced to that of a body freely moving up or down the said perpendicular, a very simple problem. Now the velocities in the plane being the same as those in the perpendicular, it is obviously immaterial whether the plane itself for descending or ascending any given number of feet be short or long, a mile, 100 yards, or 100 feet. Hence, under such circumstances, our table, p. 95, furnishes all the conditions needful for determining the perpendicular height which would enable the train to acquire a given velocity, leaving it to the engineer to lay out his plans, steep or easy, just as it suits him. Suppose, for example, that the maximum velocity wanted on a level was 25 miles an hour, we can obtain this in a run of 100 yards if we please, without any extra strain to the engine, by our table, p. 95, by making the perpendicular

fall of the first plane 20·889, or nearly 21 feet, so much being the fall due to gravity in the second column, corresponding with the required velocity in the first. If the velocity wanted was 30 miles an hour, the table shows this might be acquired with a fall a little above 30 feet; if 35, with a fall of near 41 feet; and so on with any other velocity short of 80 miles an hour.

By thus calling in the aid of gravity, any velocity wanted is had in almost as short a distance as we please, exclusive of unnecessary strain and its consequent wear and tear, and which the engine, if the velocity be not too great, can afterwards easily maintain. The great advantage of this disposition of the starting plane will be striking, if we consider, as it will presently appear, that in setting out on a level it would require perhaps 4, 5, or more miles of constant straining to approach the velocity which might thus be attained in comparatively a few yards.

In returning, the ascending plane will be just as serviceable in checking the velocity without the use of breaks or any other means; for as much velocity as the plane will give in descending, it will abstract in returning, the engine doing the same duty. But here a circumstance comes in which it will be needful to attend to, and which will fix the limit of perpendicular descent, and influence a trifle the inclination of the plane.

It is evident, in the first place, we must not give a greater perpendicular ascent than in returning we are quite sure of always possessing velocity enough to master; in the second, that the plane must not be so abrupt in its inclination as to cause a shock in coming upon it. The latter condition may easily be obviated in giving the foot of the plane a gentle vertical curvature; but the former is a point which must not be neglected, otherwise the trains coming back may stop short of the terminus.

[To be continued.]

ON LOCOMOTIVE ENGINES AND THE MEANS OF SUPPLYING THEM.

By Jacob Perkins, Esq.

To the Editor of the Railway Magazine.

Sir,

It has become a serious inquiry how the railways are to be supplied with a sufficient number of locomotive engines, as well as with a sufficient quantity of steam, and at the same time simple and easily kept in order. Until increased speed has been profitably practised, the old simple cylindrical boiler was found powerful enough to generate all the steam wanted for eight or ten miles speed, but when double that speed became necessary, much more steam was required; to effect this tubular boilers were resorted to—they certainly gave the required quantum of steam, but at the same time a host of practical difficulties followed in its train, which caused great expence in wear and tear as well as great uncertainty as to the time of transit. We believe, however, that the time is near when the generating of any required quantum of steam may be attained with great economy, without destructability to the boiler, &c.; of course there will be no stoppages on the railway in consequence of bursting of tubes or want of steam. This inconvenience of stopping by the way will find a perfect remedy in my new system of generating steam by the transmission of heat through steam, which removes all the practical difficulties experienced by the use of tubular boilers. One of this description of boilers has been tested for seven months by the most fervent heat, without the least loss of water in the tubes which transmit the heat to the interior of the boiler, where the steam is generated, neither has one particle of foreign matter attached itself to the generating tubes. The tubes in contact with the fire are not in the least injured by the intense fireing, evidently showing the great importance of their being no incrustration present between the metal and the water and steam in the interior of the hermetical sealed tubes. It has been stated by an engineer of great practical experience, that a loco should not run more than thirty miles without stopping for the purpose of cleaning the flues, &c. &c. Instead of running thirty miles only without stopping, with this new modification, the engine

would not be required to stop between London and Birmingham, since the tender would carry sufficient fuel and water for that distance, neither would the fire or flues require any attention that would interfere with its safe transit. The reasons why this new engine will run so much longer than the present without stopping, are the following:—

First.—Much less fuel will be required. Seven months, constant practice with this new boiler, has proved that more steam can be generated with the same fuel, than by the present locomotive boilers. Another source of saving fuel, is, that not half the steam will be wanted, as the engines will be worked expansively—expanding from 200 down to 50lb. to the inch, making a clear gain of 150 per cent. if the engine is properly constructed. Since anthracite coal can be used in this boiler, and as there is more carbon in this coal than in any other, less weight will answer.

Second.—Much less water is required, as but half the weight of steam will do. There will be little or no loss from leakage. The water which now goes off with the priming, which is always more or less the case as steam is now used, will by an improved system be saved and converted into steam.

Third.—There is no deposit of any kind in the hermetically sealed tube, and what would deposit in the boiler is perfectly swept off into the recipient by rapid circulation; of course no stoppage on the way is necessary on that score.

Since writing the above, I have conversed with an engineer, who says that from the great demand for locos, an adequate supply would be impossible unless some new system is adopted—in fact, it has become necessary that recourse be had to machinery.

By the aid of machinery and the division of labour, any required number may be obtained. The greatest proportion of locos may be all perfectly alike, as though they had been cast in the same mould; they should be made like the improved gun lock, every part to fit properly any other engine; in this way great facilities would be afforded in manufacturing locos. For instance, let the cylinders and pistons be got up in Manchester, the boiler in Staffordshire, the screws and nuts in Birmingham, the wheels and axles in Derbyshire, the connecting rods, &c. &c., in some other great manufacturing district; now let all the different parts be taken to one common focus, where it should be the only business of this depot, to connect the different parts and perfect the engine.

A system of this kind should not create any jealousy among locomotive engine makers; the present manufacturing establishments can manufacture but a fractional part of what is wanted in this and other countries. By machinery this country has been raised to its present eminence—by it, and by it only, can it be supported.

JACOB PERKINS.

ON RAILROADS AND WITNESSES' EVIDENCE IN PARLIAMENT RESPECTING THE TRAFFIC.

BY THE EDITOR.

Importance of having a Line to suit this kind of Traffic, and Parliamentary Caution in deciding on Rival Lines.

EVERY man who has the interest of his country at heart sees the necessity of aiding, to the utmost of his power, the formation of railroads, when bottomed on public utility, and conducted by men of honour, intelligence, and honesty. Every man capable in the slightest degree of ratiocination, and of looking ever so little beyond the present, must also see the immense influence these projects will have on the future welfare and prosperity of the empire; not only is their ostensible objects—the reduction of the time and expense of internal communication—but in the labour they will create, the circulation of capital they will cause, and the immense impetus they will give to every species of trade, how little soever it may appear to be connected with them. The only apprehensions in honourable minds are, that we are progressing too fast for our means; that we are grasping to accomplish in one or two years what ought in common reason to be the work of some sixteen or twenty; and that the popular prejudice in favour of railways will furnish food for villany to feed on, to the injury and ruin, perhaps, of thousands of innocent persons. Hence the strong denouncements every now and then made in Parliament and by the press to the wild manner in which railroad schemes are indiscriminately supported by the public. Friends as we are to railroads, and most happy as we should be to see them, whenever they can be constructed with advantage to their shareholders and the community, we are

bound to acknowledge our conviction that several now before the public, and not a few of them which have even received the sanction of the Legislature, will end in disappointment and loss.

Some are ill suited to the kind of traffic expected, and will inevitably have rival lines or ruin the places they are intended to serve. Can any one, for example, imagine that a lady or gentleman, travelling for pleasure or health, will submit to the inconveniences that a tradesman will in the object of his calling or the pursuit of gain? Whoever lays out on such a principle will certainly find himself deceived. In the commonest trades it is well understood that comfort, not inconvenience, should be an object perpetually in view, if the favour of customers, and consequently profit by them, is expected. But where wealth and fashion frequent, nothing but what will please and attract is admitted; annoyance or inconvenience is never heard of, or, if it is, it is banished as an enemy of the most dangerous cast. Does any one suppose it will be different in railroads? Certainly not. Look at the stage-coaches and the steam-vessels of the present day, and see how every whim of the public is watched for, and as soon as ascertained endeavoured to be gratified. There was a time, and not many years since, when no traveller by a stage-coach was allowed to carry beyond, I believe, fourteen or fifteen pounds weight of luggage without paying for it. An hour or more was often consumed in the middle of the journey in weighing and duly charging the extra weights to the various parties, 2*d*. perhaps to one, and 6*d*. or 1*s*. to another. This was an annoyance not long to be endured, and travellers may now, within reasonable limits, (I believe within 1 cwt.,) carry what they please. Stage-coaches were often wont to be changed two or three times in a journey of 100 miles; the public complained of the inconvenience, and it was remedied. "Now gentlemen! now ladies!" a coachman used to say, in ascending a hill, "you must get out and walk if you intend us to get up this hill." Down of course we were obliged to go and trudge on through wind, rain, and dirt to the top of the hill, scattered about the road like so many rooks in a newly ploughed field. "How is this?" said I to a coachman some years after, who was galloping up the very hill with a full load, I had often, at the coachman's request, walked up; "how is this you carry us up here? the passengers used to be obliged to walk up." "Obliged to walk up, Sir," replied he with proud indignation, "My master keeps

coaches to carry people, and if he hasn't horses able to draw 'em, he has no business to keep 'em." Precisely the same attentions must be paid to the comforts and prejudices of travellers by railroads. Parliament will do well to permit no bills to pass for lines in which there is any thing objectionable or offensive to travellers. If they do, most assuredly will they inflict a curse on the town the lines are intended to benefit, and a lamentable loss on the parties investing their money. Were it for this reason only, they should be cautious how they pass Bills precipitately when there are lines of rival merit.

In the progress of bills through the Houses, one cannot but smile at the absurd doctrines permitted respecting the traffic. Each place argues as if it was the only town to which a railroad was to be made from London. All the country round for many miles are to look on this particular line as the sole means of communication with the capital. No matter what the distance out of the way is, nor how many miles farther round; if twenty miles in fifty or sixty it is all the same, persons must send their goods and go themselves to the railway if they want to reach London, even should the intermediate roads themselves be impassable. And then the complacency with which rival lines and those that are not rival take credit for each other's traffic, and for traffic they never can carry because of other and cheaper means, are vastly amusing. For example, the Northern and Eastern line takes credit for a part of the Birmingham line's traffic, for the whole of the Great Northern's and for a part of the Eastern Counties. The Great Northern assumes to itself all belonging to the Northern and Eastern, and to the Eastern Counties. The Eastern Counties in return claims all the Great Northern's, and takes from the very sea that which it may have, and that too which it neither may nor can have. So in the advantages to be derived from this or that sort of traffic, the witnesses would make us believe that every thing of the kind was centred in the town they represent, and that theirs would be the only market from which London was to be supplied, or that the latter must be a bottomless gulph for the consumption of goods. The Folkstonians, for instance, in showing the advantages of the railway which is to pass near them for the carriage of fish, talked of boats bringing fish on the east from all the way beyond Dovor, to which the same railway is to go, and beyond Brighton, &c., on the west, to which another line will go, for the purpose of entering Folkstone, and going

from thence to London. But not contented with this moderate monopoly, they created the chimera of foreign boats bringing to them the fruits of their labours for the same market. To crown this absurdity they had only to add, that the very fish petitioned for the line, and were so delighted with the project, they would make it a condition of being caught that when dead they should be carried to Folkstone, and from thence to London by the South-Eastern Railway. Now such wisdom might well be excused in a town which is reported to have sent a solemn deputation to the Government to inquire what COLOUR they should WHITEWASH their tower to render it more conspicuous at sea; but when we see Yarmouth and other towns sharing in the same ridiculous folly, we cannot help pitying the frenzy of the times, and the poor Parliamentary Committees which have to endure it.

FALL OF TEMPERATURE IN THE ATMOSPHERE AND THEOREM FOR FINDING THE HEIGHTS OF MOUNTAINS.

To the Editor of the Railway Magazine.

SIR,

I WAS much pleased at seeing in your Railway Magazine for March last, a table giving the different decreases of temperature according to different degrees of altitude. I have always considered some such allowance to be made, but there appears to me another allowance or correction that ought to be made, and that is the correction for the natural expansion of mercury according to the temperature, that I make to be at 30° of Fahr. equal to ·0001127, or at 100° of Fahr. as equal to ·0072012; it is this point that I offer as an apology for addressing you, and I shall be obliged with your opinion on the subject, that is, if the correction for the natural expansion of mercury at any given temperature should be first made, and then the allowance mentioned in your tables; or should the allowance you speak of be first made, and then the allowance for expansion afterwards; for although at first view that may appear no difference, yet in fact there is a great one where considerable accuracy is required. In the measurement of a mountain some years

since in South America, I took four different methods, namely, the common mountain barometer, a mountain barometer on a new plan by Jones of Charing Cross, Wollaston's therometric barometer, and by trigonometry, and yet, strange to say, the greatest difference was only four feet seven inches; but there was a much greater difference in making up the same calculations by Hutton's rule, and that of De Hue, and that of Robinson.

I am, Sir, your humble Servant,
SAMUEL MOYLE.

Queen's Arms Hotel, Poultry.
8th July, 1836.

We do not clearly understand what our correspondent means by the correction for the "*natural expansion of mercury*," as applied to the fall of temperature given in our table, p. 19. If he alludes to the correction for the barometric columns of mercury in determining heights by the barometer, the barometers must evidently be reduced to the same temperature — that is, the correction for the barometric difference of temperature must be made before any step is taken in calculating the heights. Our method is always to apply the correction to the lower barometer, because it fluctuates the least; and if we are not over nice, we simply multiply ·003 by the differences in Fahr. degrees of the attached thermometers, and take the product from the height in inches and decimals of the lower barometer.

The following theorem for obtaining altitudes by the barometer is the one we have deduced from our theory of the universe. It will be found very accurate when its altitudes are corrected for the effects of latitude and vapour. (Laplace's,) with a trifling difference in the mercurial coefficients, flows from it as an approximative theorem.

$$1087 \left\{ \left(\frac{B}{b}\right)^{\frac{1}{6}} - \left(\frac{b}{B}\right)^{\frac{1}{6}} \right\} \frac{Ff}{F+f} = \text{altitude in yards.}$$

B, *b* being the heights of the lower and upper barometers, and F, *f* the Fahr. temperatures of the air at the lower and upper stations each increased by 448°. The altitude thus found is at a medium to be increased about eight yards per 1000 for the effect of vapour. There is likewise a trifling correction for the decrease of gravity which we have here not noticed.—ED.

THE BRIGHTON RAILWAYS.

STEVENSON'S line, after a contest approaching in expense and duration (eighty days) that of the Great Western, has been thrown out in committee. We repeatedly urged this before, not from any prejudice against Stevenson's line or in favour of any other, but on the broad principle that we did not think in the present state of the case a just conclusion could be arrived at, and the line best fitting Brighton, therefore, at this time, be selected. Brighton is peculiarly circumstanced, and has scarcely a parallel in England besides. Surrounded by a country destitute in our opinion of every attraction, this town has nevertheless risen to the highest point among fashionable watering-places. Its Royal residence naturally draws around it the great and the wealthy; its fine air and vicinity to the sea, attract the really ill and others who fancy they are ill; while its easy distance from town crowds it with the families of eminent merchants and opulent tradesmen, and others who are anxious to sink the cares of the week in the bosom of their family at an agreeable place. A line of railway to a town like this, therefore, must evidently be one altogether unexceptionable. If there be any thing pernicious, or inconvenient, or uncomfortable, it will consequently affect the traffic on this line more than it would on almost any other line in the kingdom. When pleasure or health is the object people will not be annoyed, and if they are once they will not submit to it a second time. A bad line, therefore, to Brighton, would certainly fail, and be fatal to the town.

We throw out these observations now the way is clear, that due caution may be exercised in the selection of a line that shall not be objectionable.

Rumours are afloat that Sir John Rennie'scompany are not likely to come again into the field. It is said they have reduced their establishment to one officer only, the Secretary. Mr. Gibbs is once more on the alert, determined, we suppose, to carry his line this time and "no mistake." It is also whispered that a triple alliance between Stevenson's party, Gibbs's, and Cundy's, has been conceived; when it will be brought forth we have yet to learn. Revolutions even more strange are talked of in the engineering department; it is said Mr. Stevenson *was*, Mr. Walker *is* to be the engineer.

Brighton is really a very happy place to be the subject of so much contention. Railway winds from all quarters seem to blow towards this one point. A gale has lately sprung up from Oxted hill, which has so exhilirated certain parties as to induce them to talk of bowling all other companies out of the field, and secure to Brighton the benefit of a railway connexion with London *via* Oxted and Croydon. We shall reserve our opinion on this project to another opportunity, not being at present in possession of all the details.

Amidst all this glorious strife we want to know how far the feelings and wishes of the inhabitants of Brighton have been consulted. We should not imagine there is a great deal of railway knowledge in the town, nor probably will its inhabitants furnish any large portion of the funds for constructing the line, simply because they are not railway speculators. Still, however, they must be the best judges of their own interest; and they have a large stake in the success of any project which is to supersede the present mode of conveyance; for if it be not a good one, farewel to their prosperity. They ought, therefore, to have that respect paid to their wishes to which their interest entitles them, and not to be treated with contemptful neglect. Is it to be endured that the subsistence of a whole town—for it is by their visitors that the people of Brighton subsist—is to be destroyed *volens nolens* by a set of men for their own private gain, who, probably, neither reside in the town, nor perhaps have any property in it? We here disclaim all allusions to either of the lines of railway; for though some of the plans have been submitted to us more than once, certain details were wanting to enable us to form a decisive judgment on their aggregate merits.

During the progress of the Parliamentary contest, we did think it our duty to remain silent. Now, however, that matters are to begin *de novo*, we shall feel it equally our duty to watch the proceedings, and just as they appear to us to deserve, so shall we speak of them. We here say nothing of the matter agitated in the House of Commons about purchased partiality, &c. Letters have been shown to us, it is true, of rather a curious cast, but in such a case we confess we do not like to draw inferences; we want that which will need no reasoning—the naked facts.

In looking over the evidence lately given on these lines of the dangers and nuisances of tunnels by medical and other men, we find there is scarcely an idea which we had

not previously published and repeated in our second Number on the "Laying out of Railways." We do not notice this for the purpose of claiming any merit in the ideas, or for being the first to expose the disadvantages of tunneling, but for the purpose of showing our readers, that we are careful what we do publish, and not in the habit of sending forth ideas which will not bear the test of examination.—Ed.

Extract from a Letter to the Editor.

"Being interested in a projected Railway in this neighbourhood, 40 miles long, which will require an inclined plane 20 miles each way, of about 35 to 40 feet per mile, I should be glad if you would give your opinion in your next—as to the practicability of such a line for passengers; viz., as to how many miles per hour a train (of the average number of those that are now going on the Manchester and Liverpool, and with engines of like power) could *ascend* and descend. I believe the average travelling on the Manchester and Liverpool is about 24 miles per hour, trains and engines of the usual length and power; and I wish to know how many miles per hour the same trains and engines would ascend and descend the incline planes before mentioned.

"There is to be a 2-miles tunnel in the line I am alluding to, which I believe is unavoidable; and as I have seen by your observations that you are very averse to them, I wish to know if your objections would not be much lessened providing they were lit with gas like the Thames Tunnel. Hoping you will excuse these imperfect remarks, I am,

"J. R."

Our correspondent must be perfectly aware, that it is not usual for questions involving calculations to settle a point in which the writer has an interest, to be put to the editors of public journals. If such questions were generally permitted, the editors had need to keep clerks on purpose to answer them. However, as answers to the present questions, in all probability, may apply to other cases we shall give them.

The velocity of ascending either of these planes will be about $\frac{1}{3}$ of that on a level, so that if the velocity on a level be 30 miles an hour up either of these planes it will be only 10. What the velocity may be down rests entirely with the

Directors. If they consider 30 miles an hour as much as can be permitted with safety they can have it, or 40, 50, or more. It is one of those cases in which velocity, almost *ad libitum*, and at a very trifling expense, may be attained. Taking the whole length of the line, an average of 20 miles an hour it is very likely may be had.

With respect to the tunnel, our opinion has been given so decidedly on that subject in our 2d No., that we cannot add anything to it here, and we see no reason whatever to alter or modify it. Two miles are a great length of tunnel. Nor will the lighting it with gas be, in our opinion, of any service except in case of accident; it will rather add to the annoyance.

THE CITY AND RICHMOND RAILWAY.*

"IF EVERY THING WHICH WE CANNOT COMPREHEND IS TO BE CALLED AN IMPOSSIBILITY, HOW MANY ARE DAILY PRESENTED TO OUR EYES; AND IN CONTEMNING AS FALSE THAT WHICH WE CONSIDER TO BE IMPOSSIBLE, MAY WE NOT BE DEPRECATING A GIANT'S EFFORT TO GIVE AN IMPORTANCE TO OUR OWN WEAKNESS."—*Montaigne.*

IF the application of this axiom be true in its reference to the arts, and particularly to those of them the better understood, and more generally cultivated, with how much more truth does it apply to the subject before us, which demands in the artist and the rare combination of the science of construction, the genius for design, and a taste and commercial knowledge of such varied character, and so indispensably necessary in its successful applications.

These observations seemed called for from us by the singular circumstances which induced the first consideration of the subject by its enterprising projectors, and secondly, the complete success which the undertaking promised, and indeed realized for them as a reward for the anxiety, labour, and perseverance, which attended their perfect organisation of the scheme now actively progressing towards Parliament as the City and Richmond Railway. To pro-

* We wish our correspondents had given us the statistics of this line; it would afford some curious matter.—ED.

ceed, therefore, to a descriptive account of this undertaking. It should be stated, that it is essentially a Metropolitan Junction Railway, centralizing in the very heart of the capital, and forming a common terminus for the extraordinary number of eight of the certainly most important railways directed towards the metropolis,—the Birmingham, the Great Western, the Southampton, the Portsmouth, the South-Eastern, the proposed Brighton, the South-Western, and the Richmond Railways, without taking into consideration the tributary undertakings which regard these national and magnificent works as the great arteries of communication with the metropolis. Looking, therefore, at the enterprise before us as effecting a COMPLETION to any ONE only of these Railway undertakings, it bears the stamp of usefulness and the promise of success; but regarded in its real and compound character as effecting successfully the same object FOR THEM ALL, it must remain an inexplicable mystery why the Railway before us has never been proposed by any one of the Companies it purposes to complete, seeing that their respective Companies, without a single exception, have had no metropolitan terminus, either proposed or contemplated in their Bills, and respectively incapable of effectively approaching the Metropolis otherwise than by a fresh application to Parliament for extended powers. The more successfully and satisfactorily to point out the merits and capabilities of the line before us, is briefly to state the termini of the various Railways it brings to the Metropolis and the port of London. In the order, therefore, in which they are enumerated above, the termini of the Birmingham Railway is at Holsden Green, Somers Town, and at Camden Town, to arrive at which place, even three miles from the Bank, the wearied traveller is subjected to the danger, difficulty, and annoyance of two tunnels, which we believe are thus:—the first of one mile and a quarter, and the second of one mile in length, and were there, in our opinion, no other practical difficulty in such termini, the tunnels themselves, so immediately following each other, offer so valid and serious objection, that in practice it will be found, that he who is perhaps suffering from sickness, exhaustion, and fatigue, will prefer to arrive at his journey's end through the open air and in safety, than volunteer a forlorn hope as regards his health, through the condemned cells of the London and Birmingham Railway. These observations regard only the passengers on this line. The goods are proposed to be deposited at Camden Town on the banks of the

Regent's Canal. Disturbed from their original consignment to an uncertain water-carriage, on a tortuous and almost impracticable canal, with the uniform loss of six hours in their delivery—a period, it will be observed, only occupied on the Railway from Birmingham itself, and delivered at last at the mouth of the canal, instead of being warehoused or shipped for exportation as proposed by the City Railway Company, out of the very trains, without disturbance or the risk of injury, which brought them from the north. The next important railway without a terminus, or the means of approaching London is the Great Western, who originally contemplated a junction with the Birmingham Railway at Holsden Green. This project being abandoned, a terminus is proposed in the neighbourhood of Notting Hill and Bayswater, equally distant and inefficient to the purposes and wants of the metropolis. Having explained the present condition of these works, we shall proceed to the proposed City Railway. Its commencement may be said to be at either end of the line. However, we shall follow its course as laid down by the accompanying map, from its junction with the railways above described. At Holsden Green, therefore, it takes up the Birmingham line, one mile short of the first tunnel from that place, and proceeding southward through Wormwood Scrubs to a point of intersection with the Great Western line, near East Acton, it proceeds through Shepherd's Bush to the Uxbridge Road, and from this road through Brook Green to the Hammersmith Road, running nearly parallel to the Kensington Canal through Walham Green to the Thames; where the Company propose their viaduct or bridge, and crossing the river, the railway proceeds to the junction of their Richmond branch at Battersea, and proceeding for a short distance parallel to the Southampton Railway, which it necessarily must do to obtain the proper level, takes up that railway about a mile from its terminus at Nine Elms, it thus joins with the City Railway upon the same level, and enables it to pass by a viaduct over the streets into the metropolis from Nine Elms, and consequently from this undertaking takes all the other South-West and South-Eastern Brighton and Portsmouth Railways, which at present regard the Southampton line as their termini. From which place the line of the City and Richmond Railway proceeds through Lambeth, crossing the Westminster Road, the Waterloo Road, and the Blackfriars Road, to the terminus of the line at the Company's wharfs and warehouses at the foot of Southwark Bridge; a portion of the line will be on a viaduct

tastefully converted into dwellings, shops, markets, &c., forming a handsome and leading thoroughfare from Southwark Bridge to Vauxhall, which is so much desired by the inhabitants; the Bridge Roads will be traversed by arches of uniform character and materials with the several bridges to which they belong. Having stated thus much of the proposed junctions of this undertaking, and pointed out the important relationship it possesses with the great works now in progress, we shall close this article, after explaining another equally, if not more, lucrative character it will bear from its singular and advantageous position as regards many divisions of the metropolis. As AN OMNIBUS RAILWAY, therefore, to the following places, or their immediate neighbourhoods, this undertaking possesses singular advantages. From Southwark to Blackfriars, Waterloo, Westminster, and Vauxhall Bridges, to Lambeth, Vauxhall, Battersea, Wandsworth, Putney, Barnes, Mortlake, Richmond, Kew, Petersham, Ham, Kingston, Hampton, Teddington, Twickenham, Hounslow, Isleworth, Brentford, Ealing, Acton, Chiswick, Hammersmith, Kensington, Chelsea, Brompton, Fulham, Uxbridge Road, Harrow Road, Walham Green, and the other adjacent places in those neighbourhoods, to which there is a continual stream of passenger traffic of great extent, and these places are only to be approached by tortuous and indifferent roads, great loss of time from crowded thoroughfares, with the most insufficient and expensive coach and omnibus conveyance. Another great feature of this undertaking is the circumstance of its being the only practicable North and South Junction near the Metropolis which can be effected, giving to the various railways now in progress the invaluable addition of a connecting link throughout the kingdom. In conclusion, it affords us great satisfaction to be able personally to speak of the talent and energy exhibited in the plans, &c. in active preparation by the engineers to the Company, many of which have been exhibited to us by favour of the Directors, together with a most elaborate and complete survey of the line, and we heartily congratulate the shareholders on the circumstance, in the firm conviction that if the undertaking continues to be advanced with the same spirit, high character, and professional skill it has already received at their hands, it cannot fail to be received by Parliament with great favour, and, as it deserves, to be crowned with complete success.

J. A. and T. F.

THE EVIDENCE OF GEORGE WALTER, ESQ. RESIDENT DIRECTOR OF THE LONDON AND GREENWICH RAILWAY, BEFORE A COMMITTEE OF THE HOUSE OF LORDS, JULY, 1836, ON THE DIRECT BRIGHTON RAILWAY BILL: IN WHICH THE CAPABILITIES AND IMPORTANCE OF THE GREENWICH RAILWAY ARE SHOWN.

[CONSIDERING the importance of the Greenwich line as the trunk of others from the east, and the interest of the public being much excited by its approaching opening, we have, in compliance with the wishes of several friends, given Mr. Walter's late evidence before the Lords, freed from the numerous questions of counsel. —ED.]

Am resident director and superintendent. Have had experience in other railways. Seen the Liverpool and Manchester Railway, and passed over it several times. Am aware of the capabilities of the Greenwich Railway for traffic by passengers. It is constructed on arches, with two lines of rails, and is expected now to be finished in about a fortnight or three weeks. It is twenty-five feet width, and twenty-two in the clear between the parapet. The Greenwich Company contemplated that it might become necessary hereafter to widen the railway, and purchased twenty-five feet on each side of the railway, making together seventy-five feet; whereas twenty-five only was necessary for the two lines of rails. This would allow us to construct four lines of rails, that is, two double lines of rails more. The land on the south side of the railway, at present, is merely occupied as a footpath, which produces an additional income to the Greenwich Company of about 1,000*l.* or 1,200*l.* a-year. The ground on the north side of the railway, at present, is applied for the purpose of carrying the materials necessary for finishing the works. The Company have also purchased additional ground for the enlargement of their station, if necessary, and have power to purchase considerable property, which is in the Schedule, but which is not considered necessary. At present locomotive engines are running on the railway on the part that is finished. The experience that has been given enables me to speak of its capabilities for traffic, and to say they are very considerable, and equal to any traffic we expect to have on it. The greatest number of passengers we have carried on any one day was on Easter Monday, in the afternoon. In the latter part of the day we carried 6,312. The time was principally between twelve o'clock and eight or nine, 3,000 one way and 3,000 the other, as near as possible; till three o'clock, every half-hour; after three, every twenty minutes. We had one engine and seven carriages in each train, each way. Each trip, two miles and a

quarter took about six or seven minutes. If all the seven carriages had been filled, with one engine we could have carried in that time 10,920. With twelve carriages carrying thirty passengers, running twelve hours a-day, we could have carried 17,280, starting every half hour; at twenty minutes it would be 25,920. With the same means of conveyance, and starting every quarter of an hour, we could carry 34,560; and every ten minutes, 51,840. I think it very probable we shall start every ten minutes, or even every five minutes, from each end, on extraordinary occasions.

The distance of the junction of the Greenwich Railway from the Croydon is a mile and three quarters from London Bridge. It is to be made by arrangement with the Croydon Company, under the superintendence of the engineer of the London and Greenwich Railway. I know of no difficulty and no danger in this junction. There is a man stationed at the junction by agreement with the Croydon Company. This man is to give notice, and the train is always to draw up when it comes near the point that is to join the Greenwich line, to regulate the coming of trains upon the railway, the same as is done on all railways. Suppose trains start at every half hour, it would occupy less than a minute in coming from one line to another, which, if we started every half hour, would be about twenty-four minutes, if we worked twelve hours in the day. If we went every five minutes, we should have plying two engines.

At the London terminus there are six lines of rails, and there is space for two more lines of railway. The space there is about 280 or 300 feet in length, by 60 or 65 feet in breadth, which is enclosed by parapet walls. The Greenwich Railway has considerable tracts of ground independent of the seventy-five feet, and have sold, for a station to the Croydon Company, a considerable space.

These two Companies will start their trains under the arrangements of the engineer of the Greenwich Company, which will produce a unity of operation. Our own station at present is about, I should conceive, half an acre. Besides that ground, the Croydon Company has additional ground, part of which they purchased from the Greenwich Company, and part of which they have recently purchased under their Act of Parliament; but I believe their purchases are not yet completed. They have power to purchase to a very considerable extent. There has been an agreement in writing between the Croydon and Greenwich Companies as to stationing men to do whatever is necessary at the point of junction.

The Greenwich Railway is to be lighted with gas, which would greatly obviate any danger at the junction. Being on arches, in the day-time trains can see each other at a considerable distance previously to coming to the point of junction, and at night the point of junction is lighted by gas. A model of the junction is here. [The witness describes it by the model.]

The expense of widening the Greenwich Railway, as far as the

Croydon junction, would be about 100,000*l.*, for laying down a double set of rails. We have a depot at Deptford, with ground to widen the station there if necessary. The Company has between forty and fifty acres on each side of the railway, exclusive of the seventy-five feet in width which it is intended to sell for frontage for building. Supposing the Bill of Sir John Rennie had passed, the Greenwich Railway Company would widen the railway to accommodate the traffic from Brighton, if it had been found necessary, they having all the ground for that accommodation. The Greenwich Railway Company would be very happy to have any additional traffic, and they have the means of accommodation. To make the additional lines of rails that would be necessary for that accommodation, I think might be eight or nine months, at the expense of 100,000*l.*

Cross-Examined.

The interval at which we propose the engines should be started on the Greenwich line, when the line is in full play, is not exactly determined, but I should conceive every quarter of an hour on ordinary occasions, and on very extraordinary occasions every ten minutes, or perhaps eight or five minutes. They run the distance to Greenwich in about ten minutes; so that there will be two trains going at once upon the line, which they start every five minutes. One of our carriages holds thirty.

The Croydon depot is on the north side of our railway. When we start the trains every ten minutes, we conceive our two lines of rails will be sufficient accommodation for the public if the Brighton Railway comes on our line. There can be no difficulty in starting a train every minute; and we would not mind bringing the Brighton Railway on to our line, even if the trains were starting every minute. Colonel Landman projected the scheme, and they are pleased to give me the credit of having formed the Company to carry it into effect.

Examined by the Committee.

We expect a great accession of passengers when the line is finished to Deptford. In consequence of the number of persons going to the steam-vessels and back again, we have a little railway of about 750 yards at our terminus at Deptford to the Deptford Pier, which is now in execution; and we think it very likely that steamers will stop there instead of coming up the Pool at night; it will save them upwards of an hour in getting through the Pool.

We have power to borrow 133,000*l.*, which we have done, and which we have also nearly expended. When the works are completed, I conceive we shall have expended the whole of the 133,000*l.* in addition to the 400,000*l.*; but for that 133,000*l.* we have property of about forty acres of freehold frontages on each side of the railway, valued by our surveyor at 112,900*l.* We have ground not only for two lines of rails on the south side, but also for two lines of rails on the north side, making altogether six lines

of rails, and have a margin. Trains coming in on the north or south side will be a matter of arrangement. If trains come in on the north side, there would be no crossing; and any difficulty or danger that might arise from crossing could not exist under those circumstances. We can attach to an engine on the Greenwich Railway from twelve to fourteen carriages on occasions. Having seven carriages to an engine we could carry nearly 10,000 persons at the intervals mentioned, and by attaching fourteen carriages, double the number of passengers in the same intervals. Generally speaking, with all the increased traffic we contemplate, we should not require to start at lesser intervals than a quarter of an hour; butat every ten minutes or every five minutes on extraordinary occasions.

If there are several engines going nearly about the same time on the one or the other line of rail, they must follow in train; they must wait at the terminus till the train has passed, and cross over and get upon the line of rails. I should conceive they would cross at a very slow pace; six or seven miles an hour. There will not be inconvenience from that. From the short space they will have to cross over, and the crossing occupying so short a time, it would not, I think, be attended with any difficulty.

MR. STEVENSON'S EVIDENCE ON THE BRIGHTON LINE.

[Continued from page 147.]

It will be, in point of fact, about half way between London and Brighton?—Yes, or scarcely that.

So that, in point of fact, the ascent and the descent will be equalised on both sides?—Pretty nearly so, but not exactly.

As far as the general feature of the line goes, that is the character of it?—Yes.

It is just beyond that that the line proceeds out of the county of Surrey into the county of Sussex?—Yes.

From that point of the highest level at Capel, you begin then gradually to descend into the valley of the Adur?—We descend to Horsham; in fact, we descend into the valley of the Adur.

In the course of that descent you have a considerable embankment at Horsham, or two embankments?—That is the largest work in the whole.

Is that the largest work that you will have to do on the line?—Yes, it will be.

In all these works the duration of the whole work depends upon the duration of that which will take the longest period, does it not?—Yes.

And that you begin executing first?—Yes.

In your judgment, within what period of time can this your largest work at Horsham be executed?—I have estimated it at two years and a half; but I think it may be executed in two years.

That embankment will be somewhere between 26 and 82 miles upon your line?—Yes.

You say that that work, in your judgment, you estimated to be completed in two years and a half, and may be completed in two; will you have the goodness to tell me whether in that work, being an earth-work, excepting in its extent, you have any reason to apprehend a difficulty in executing it?—No, I have no reason to apprehend any, except from its extent.

And is there any particular difficulty attending its extent of work exceeding the time that it will occupy?—It is a mere question of time.

It is simple earth-work?—Simple earth-work.

In works of this description in railroads, comparatively speaking, is not earth-work the least expensive work that you have, particularly where the lead is not very long?—Certainly.

The lead here will not be very long?—No, it is not very long.

Then I believe I describe the line accurately in saying, that from that point you descend gradually into the valley of the Adur?—Yes.

Is there any difficulty at all in the descent down that valley?—No.

When you get down towards the valley, you get into a peculiarly favourable line from thence till you get to the sea?—Yes.

When you get to the sea at Shoreham, you have almost a dead level along the cliff to Brighton?—Yes, it is exceedingly level.

Describing that line generally, and considering the experience you have had in making railroads, which, I presume, you never expected to make without some natural difficulties, in your judgment is or is not that a line opposing to you less natural difficulties than you ordinarily meet with?—I think so, decidedly.

In respect to a communication between London and Brighton, do you believe that there is any line that will afford less natural difficulties than that line through the Dorking Valley and Adur Valley to Brighton?—I believe not.

Chalk is a very favourable soil, is it not, for the execution of these sort of works?—Yes; but I like to have clay just as well as chalk for tunnelling.

Do you apprehend that there would be any peculiar difficulty in tunnelling through that chalk?—No, I do not apprehend any.

What is the length of that tunnel?—About 900 yards, I think.

And the height and the width of that will be about the same as the other, I presume?—No; it will be the same height, but not so wide.

Is that because a portion of the traffic will have been divided?—Yes; I consider that a single line there is sufficient.

In a work of this description it is important, with a view of keeping down the expense, to make it of only the dimensions that are absolutely necessary?—Yes.

By the Committee.—How many feet wide will it be?—Fifteen feet wide.

By Mr. Sergeant Merewether.—The tunnel which you will have to make there will be near the close of the journey?—Yes, it will.

I believe it is the universal practice to lessen the speed when you get towards the end of your journey?—It is a matter of course.

On that account also is there less reason for more room in your tunnel?—I think so.

With respect to ventilations there, if you want less speed, and therefore less power, will ventilation be less necessary in a tunnel of that kind than if it is used in the midst of the main line?—It will be less necessary.

Do you resort to any means of ventilating, then, or trust to the natural ventilation of the tunnel?—I should trust to the natural ventilation of the tunnel from the two apertures.

Will that be sufficient?—Yes; but if it is not sufficient, I would use a stationary engine, as they do at the Liverpool Railway, to draw them in and out of the depot.

And by that means you would avoid the locomotive engines going through the tunnel, and would not have the difficulties of smoke and steam, and so on?—Yes.

Then extra ventilation is unnecessary?—Yes.

I need hardly ask you whether in the formation of a railroad the expense of the original formation is not a most material ingredient, an element to be considered?—Most decidedly.

Is not also the expense of the future maintenance of the railroad afterwards, if possible, a more important consideration, as being perpetual and constant?—I do not think that is more important, but it is an important consideration.

Will you have the goodness to tell me, whether you find by experience that the expense in the support of a railroad, the maintenance of a railroad, and the security of it afterwards, is increased if the gradients are not good?—Very much increased.

With reference to the application of power upon the gradients, and the chances of dislocation of the rails, and the general difficulties of support, do you not find practically that they are much increased by the gradients?—Yes, what is usually called the wear and tear of the establishment is very much increased by increased gradients. When I say of the establishment, I mean the locomotive power and waggons and carriages.

Do you find that the waggons and carriages are much injured when they are driven at more than ordinary power, in order to overcome a disadvantageous inclination?—Certainly.

You find that experimentally?—Yes.

Now having asked you whether the expense of the formation of the line and the expense of maintenance are not the important points, I would ask you whether, considering in comparison with them directness and shortness of line, they bear any comparison

in respect to importance?—They are to be compared, and one is to be placed against the other. The view that I have taken all along in laying out railroads has been rather to go round than to go over high ground.

You find by experience that that is the most convenient?—Yes.

As velocity is so easily commanded by a railroad, small detours are not to be compared with the expense of going over high ground?—Of course there is a limit to that; but usually a level through a circuitous course is better than an undulating direct one.

Finding that the unequal grounds of the South Downs are interposed in the direct line between London and Brighton, have you been led to take somewhat of a detour by the Valley of the Adur rather than encounter the difficulties of the high ground?—Decidedly; and there is no other gap in this ridge of hills but in the line which I have taken.

In an engineering point of view, have you any doubt whatever but that is the best course to adopt?—I have not the smallest doubt of it.

Have you any doubt, in going round by the Adur, of preferring that to that line which would go over the higher ground?—I have no doubt in the present instance.

REVIEW OF RAILWAY BOOKS.

"*The Practical Mechanic's Pocket Guide,*" by R. Wallace.

[Continued from p. 228.]

In the single acting engine, the loss of motive force due to the same causes is ·402 of the pressure of one atmosphere: hence, the effective pressure is ·598 of this pressure. To determine the mean effective pressure, when the force of the steam in the boiler is different from that of the atmosphere, *multiply the given pressure in inches of mercury by* ·598, *and from the product subtract the pressure due to temperature of the uncondensed steam, the remainder is the pressure required, in inches of mercury; multiply this pressure by* 14¾*lbs., the atmospheric pressure on a square inch, and divide the product by* 30, *the quotient is the mean effective pressure on a square inch of the piston,* which, *multiplied by* ·7854, *gives the pressure per circular inch.*

In the double acting engine, the loss of motive force due to causes above mentioned, is estimated by Mr. Tredgold at ·368 of the pressure of one atmosphere, hence the effective pressure is ·632 of this pressure; consequently, the mean effective pressure on the piston, when the force of the steam in the boiler is different from that of the atmosphere, is found by the rule in the preceding article. The force of low pressure steam in the boiler is generally equivalent to that of 35 inches of mercury, the temperature being

220°; and the temperature of the uncondensed steam 120°, its force being equivalent to that of 3·7 inches. Hence for the single engine, we have $35 \times \cdot598 = 20\cdot93$ inches, and $20\cdot93 - 3\cdot7 = 17\cdot23$ inches; whence $17\cdot23 \times 14\cdot75 = 254\cdot1425$, and $254\cdot1425 \div 30 = 8\cdot47\cdot142$ lbs. nearly, per square inch; consequently $8\cdot47142 \times \cdot7854 = 6\cdot66$ lbs. nearly, per circular inch. For the double engine we have $35 \times \cdot632 = 22\cdot12$ inches, and $22\cdot12 - 3\cdot7 = 18\cdot42$ inches; whence $18\cdot42 \times 14\cdot75 = 271\cdot695$, and $271\cdot695 \div 30 = 9\cdot0565$ lbs. per square inch; consequently $9\cdot0565 \times \cdot7854 = 7\cdot1$ lbs. per circular inch.

To calculate the Power of a Steam Engine.—The common atmospheric engine.—Multiply 5·9 times the square of the diameter of the cylinder in inches by half the velocity of the piston in feet per minute, and the product is the effective power in lbs. raised 1 foot high per minute. Divide this product by 33,000, and the quotient is the number of horses' power. 2d. The atmospheric engine with condenser.—Apply the above rule, but instead of 5·9, use 6¼ for the multiplier. 3d. Single acting engine.—Multiply the mean effective pressure on the piston by the square of its diameter in inches, and by half the velocity in feet per minute, and the product is the effective power in lbs. raised one foot high per minute. The number of horses' power is found as above. 4th. Double acting engine.—Apply the preceding rule, but instead of half the velocity use the whole of it for a multiplier.

To calculate the Power of an Engine when the Steam acts Expansively.—1. In the single acting engine.—Multiply 2·3 times the common logarithm of the reciprocal of the fraction, denoting the portion of the stroke made when the steam is cut off, and to the produce add 3; then multiply the sum by that fraction, and by the whole force of the steam in the boiler, in lbs. per circular inch; the product is the mean effective pressure on the piston, with which proceed as directed in the double acting engine. Divide 2·3 times the common logarithm of the reciprocal of the fraction, denoting the portion of the stroke made when the steam is cut off by the reciprocal itself, and multiply the quotient by the whole force of the steam in the boiler, in lbs. per circular inch; the product is the mean effective pressure on the piston, with which proceed as directed in the preceding paragraph.

"*A Treatise upon Elemental Locomotion,*" by Alex. Gordon, C.E.

MR. ALEXANDER GORDON, C.E., has just published a work under the above title, the object of which is to advocate the application of steam carriages on common roads in preference to railroads. Mr. Gordon writes like a man well acquainted with the subject he writes on, and warm in the side he takes. He has advanced some circumstances which certainly deserve our serious consideration. We are prejudiced in favour of railroads only insomuch as we think them furnishing the means of more rapid and economical transport. If a better method was proposed we should not hesitate to give it

our humble support. It would be going too far to say our opinion of the superiority of railroads is shaken as far as we have yet read in Mr. Gordon's book, and we should be acting uncandid if we did not acknowledge that several of his arguments and positions could not, in our opinion, be easily answered. We have ever thought that steam-carriages can be made to run with comfort and convenience on common roads, but whether they will at any time be made to rival railroads in celerity and cheapness is a question not less difficult than important, and which, for the present tense, must be answered in the negative. However, we purpose to give this subject our best consideration, and if our opinion should then be changed we hope we shall not want candour to own it. In the meantime we can recommend Mr. Gordon's book as containing a better history of what has been done with steam on common roads, and as detailing more facts connected with the practical operation of the subject than we have yet seen in any other author. His history of the invention and progress of improvements in locomotive boilers is particularly deserving of attention; the great drawback is that his plates are not good and are badly lettered.

SCIENTIFIC AND MISCELLANEOUS INFORMATION.

Irradiation of Light.—It is a curious fact that if the same letters of the same size precisely are painted on two boards, the one white on a black ground, and the other black on a white ground, that the white letters will appear larger and be read at a greater distance than the black. This is owing to what is called the irradiation of light. It depends on this that the impression made on the bottom of the eye by bright objects, extends a little wider than the actual portion of the organ struck by the light, and invading the space occupied by the darker objects makes the brighter appear larger than they really are.

Astronomical Phænomenon.—A curious phænomenon in astronomy, is, that a star about to be eclipsed by the moon will actually appear to advance within and upon her bright part, and "sometimes considerably" before it disappears behind her. This has been considered to be a very difficult phænomenon to explain. We have no doubt but it is referable to the same principle that makes the illumined part of the moon appear, when the moon is a day or two old, so much larger than the darker part, and actually to clasp it. This phænomenon, which is partly owing to irradiation, and partly, perhaps, to the lunar light a little beyond the visible part of the moon being bent by the moon's attraction towards a point on one side of her, extends her apparent diameter beyond her real. Hence the more vivid light of the star will

appear through the false diameter of the moon, and will not disappear until interrupted by her real body. If this explanation be true, the phænomenon will be more marked the brighter the star, and the farther the moon's path is from the centre of the star at the time of the occultation, the longer also will it continue. It ought also equally to hold good at the emersion if it happen in the illumined part of the moon.

A Long Yarn.—"A bale of Demarara cotton can be spun, and is made into thread, which would reach from the earth to the moon."—*Gordon's Treatise upon Elemental Locomotion, p.* 342.

We may with propriety call spinning this thread 240,000 miles "spinning a long yarn." We only want Perkins's steam gun to carry one end of it, and twist it round the neck of a lunarian, to execute him according to terrestrial law.

"*The Turnpike Roads* of England and Wales alone, exclusive of highways, extend 19,800 miles in length."—*Ibid, p.* 343.

If we have to make railroads in lieu of all these, civil engineers, Parliamentary agents, barristers, attorneys, surveyors, &c. &c. &c. will have a glorious time of it for some years to come.

Supposing these lines to occupy six acres to the mile, they would take up 118,800 acres of land, and would cost, at the low estimate of 12,000*l.* per mile, 237,600,000*l.*, about half of which we presume would be spent in labour. If they were rated to the poor at 2*s.* in the pound, on barely the interest of their cost, they would produce rates collectively amounting to 7,128,000*l.* per annum, that is somewhere about one million less than the total sum at present collected for poor-rates, or $\frac{7}{8}$ths of the whole. This is independent of the employment they will give afterwards, and the trade they will create. Who after this will say railroads, when completed, will not help us in our burthens? Assuming we could spend £10,000,000 per annum on them, they would take 23$\frac{3}{4}$ years to complete, and at only 200 tons of iron per mile, would consume near four million tons of iron in the rails, besides iron for the engines, carriages, &c. &c.

Calculations of this sort are easily made, but who could tell us how many hundred thousand lies per mile the counsel and witnesses will tell to carry the lines through the committees? Really, if things go on as they have in committees, his Satanic majesty must enlarge his dominions, and provide extra room for the increased population he may expect of lawyers, engineers, and professional witnesses.

Hydrostatic Carriage.—"A mechanician of Haunkenzell, in Rhenish Bavaria, named Schmidtbauer, has invented a carriage of very simple machinery, which he puts in motion by the application of the hydrostatic process. This vehicle runs on ordinary roads at the rate of about 16 *leagues an hour!* The model of it has been purchased by an English house."—*Journal du Commerce d'Anvers.*

New Locomotive Power.—Mr. Mullins, M.P. for Kerry, has made a very important discovery in the scientific world, that of applying galvanism, instead of steam, for propelling vessels and carriages. He is now building a carriage upon this principle, and several of the first engineers who have seen it, say there is every prospect of success, and that it will supersede steam.—*Limerick Star.* The *Dublin Evening Post* claims the merit of this invention for the Rev. J. W. M'Gawley, one of the clergymen of the Roman Catholic cathedral of that city, who, that journal says, explained it at the meeting of the British Association there last August. "The discovery," proceeds our Dublin contemporary, "has excited interest among the *savans* of Germany by Mr. M'Gawley's interesting and important invention, which is to form one of the most attractive features of the British Association at its approaching meeting in Bristol.—*Worcester Journal, 10th August.*

British Scientific Association.—The most splendid meeting ever held by the Association has just been closed at Bristol. This city has done itself great honour by the spirited and munificent manner in which it has received the Association, and by the liberality with which every thing valuable and worth seeing has been thrown open to the members. The chief difficulty experienced was owing to the separation of the sectional Committees in distant parts of the city, which, however, was unavoidable. Some valuable communications have been made to the sections in mathematics, physics, chemistry, geology, &c. &c., but very little with respect to railways. Indeed, we have seen with surprise how little men of science appear to understand this subject, now one of the most important to civilized society. In our next we may have an opportunity of adverting to a discussion that took place between Mr. Davies Gilbert, Professor Mosely, Dr. Lardner, and the Editor of this Journal, which will fully bear out the observation we have made.

PROGRESS OF RAILWAY WORKS.

LONDON AND BIRMINGHAM RAILWAY COMPANY.

Sixth Half-Yearly General Meeting of the Court of Proprietors.

EXTRACTS FROM THE REPORT.

Birmingham, August, 1836.

The Directors have the satisfaction to announce to the proprietors, that the progress of the works generally, in the last six months, has been such as to warrant the expectation which was held out at the last meeting, that the whole line will be completed

by the summer of 1838, and the first twenty-one miles from London in the spring of 1837.

Of the Primrose Hill Tunnel, which is 1105 yards long, only 114 yards remain to be made; the Kensal Green Tunnel is finished, and traversed by the Company's locomotive engines; 1428 yards are completed of the Watford Tunnel, the total length of which is 1793 yards, and the difficulties which were presented by the quicksand in the Kilsby Tunnel have already been so far surmounted, as to leave no doubt in the mind of the Company's engineer, that they will not delay the opening of the Railway beyond the time mentioned. With reference to the other portions of the work, the Directors are making every exertion to forward them, so as to give the proprietors the benefit of a revenue at the earliest possible period; satisfied that although for the attainment of this object an additional charge will be incurred by the Company, the advantage to be derived from it will be more than commensurate to the expense.

The Directors have entered into a contract, under the guarantee of two responsible sureties, with Mr. Edward Bury, of Liverpool, an able and experienced builder of locomotive engines, for the conveyance of passengers and goods, on the railway, by locomotive power, to whatever extent may be required, at a fixed rate of remuneration; the Company providing engines of Mr. Bury's specification, and Mr. Bury on his part maintaining and keeping them in repair; the contract to be in force for three years from the opening of the railway. The Directors have also contracted for such locomotive engines as will be first wanted, and for a portion of the carriages.

The Directors in referring to the bills for railways, connected with the London and Birmingham, which have received the Royal assent in the present session, feel themselves called upon to congratulate the proprietors on the great accession of traffic which they may anticipate, from the direct communication opened with the northern and eastern parts of the kingdom, by means of the midland counties, north midland, and Birmingham and Derby Railways, not to mention the connexion between Birmingham and Gloucester, by the Birmingham and Gloucester Railway, nor minor lines, which will all contribute to swell the revenue of the Company. Acting upon the suggestion of the proprietors at the last general meeting, and considering it desirable that a connexion should be secured with Leamington and Warwick, the Directors have instructed the Company's engineer to ascertain the levels for a branch line to those places, to join the London and Birmingham Railway near Coventry; and they have also set on foot the usual investigation into the traffic, so as to be prepared to follow up the object with such measures as may, in the opinion of the proprietors, be deemed expedient.

By the statement of accounts now to be laid before the proprietors, it will appear that

The receipts to the 30th June were .	£1,955,608	0s.	5d.
The disbursements	£1,492,100	16s.	8d.
That the balance, in favour of the Company was, at that date	£463,507	3s.	9d.

And that the amount received on loan pursuant to the powers given by the last general meeting, was 443,800*l*.

It is estimated that the liabilities of the Company, for the next six months, will be sufficiently met by the cash at their disposal, and by loans which have been tendered and agreed for, with the addition of calls. Great as the present scale of expenditure will appear, the Directors are satisfied that so long as the works proceed with energy proportioned to that expense, the proprietors will hail the increase as an additional evidence of the approach of their great undertaking to completion.

General Account of the Receipts and Disbursements of the London and Birmingham Railway Company, to 30th June, 1836.

Cr.

1836.		£	*s.*	*d.*	£	*s.*	*d.*
June 30.	By calls, viz :—						
	60 per cent. on capital	1,500,000	0	0			
	Due from sundries .	5,612	14	9			
	Cash received				1,494,387	5	3
,,	By loans				443,800	0	0
,,	By miscellaneous receipts, viz.—Penalties . .	1,505	0	0			
,,	Land re-sold and rents .	730	0	3			
					2,235	0	3
,,	By interest, viz:—(1) On exchequer bills and bankers' balances	14,059	17	5			
	(2) On calls in arrear .	1,125	17	6			
					15,185	14	11
					£1,955,608	0	5

Dr.

					£	*s.*	*d.*
,,	To expenditure as per statement annexed	1,492,100	16	8			
"	Balance at the disposal of the Company	463,507	3	9			
					£1,955,608	0	5

Statement of Expenditure to June 30, 1836.

Payments for obtaining act of incorporation	72,868	18	10
Land and compensation	553,182	2	10
Conveyancing	4,521	14	1
Contracts for works	796,356	2	5
Engineering	34,287	8	5
Law charges for general business	4,111	15	4
Advertising and printing	2,426	3	11
Direction	6,091	2	7
Office charges, salaries to secretaries, &c.	11,955	11	10
Sundry expenses, travelling charges, &c.	4,220	4	5
Stamps, debentures, and incidental charges	2,079	12	0
	£1,492,100	16	8

R. CREED, C. R. MOORSOM, } *Secretaries of the Board.*

Great Western Railway.—This undertaking is being carried forward with great spirit, and promises in every respect to be equal to any work of the kind in the country. Since the passing of their act in September last, the Company have made ten contracts for different portions of the line, extending from Hanwell to beyond Maidenhead at one extremity, and from the river Avon to the Cross Post turnpike at Tiverton, between Bristol and Bath. These contracts, extending in the whole about thirty miles, include all the heaviest work upon the line, with the exception of the tunnel at Box, for which also, we understand, tenders will be shortly received, so soon as the experimental shafts making under the direction of the Company, are completed. The contracts have been made very satisfactorily, being a moderate per centage below the engineer's estimate, and no doubt is entertained that they will be completed within the specified time. At Hanwell, on the Uxbridge road, where the Railway crosses the Brent river, a viaduct of five proportions, and an extensive embankment are in a very forward state. The embankment is wholly formed of gravel, obtained from the surface of the adjacent land, and which proves a most excellent material for the purpose. A visit to this part of the works is easily made by means of the Uxbridge coaches, as the road runs nearly parallel to the works for some space, and is afterwards crossed by the line, which will be conveyed over it by a handsome and substantial bridge, the piers of which are nearly completed. The whole of the work in this contract seems to be done in excellent style. The contract is now advertised, which will bring the railway eastward towards London, as far as Lower Place in Acton parish, from whence it will proceed to a terminus

at Paddington, the Directors having finally determined that a distinct terminus is necessary for the great traffic which this line must convey, instead of falling into the Birmingham line, which will have abundant traffic from its northern branches. The Directors will apply in the next session of Parliament for an act to construct this terminus, but as the works will not be heavy, no delay will take place from this circumstance in opening the line as far as Maidenhead, which it is expected will take place in the course of next year, or early in 1838. About the same time, or shortly after, the line will also be completed between Bristol and Bath, thus connecting the two most important cities in the West of England, and affording a source of revenue to the Company, whilst the remainder of the line is in progress. The Directors have rightly directed their first attention to those parts of the line which will require the most time for their completion, and at the same time, as it happens (with one exception) are so situated as, when finished, to become immediately productive of a large proportion of the estimated revenue. It is unnecessary for us to remark what a stimulus great works like these must give to the energies and industry of the country. On the contracts between Bristol and Bath alone, we understand upwards of 1500 men are now actively employed, and a greater number will be shortly required as the progress of the works admits. At Bristol the Company have purchased of the corporation an extensive piece of ground as a depot, called Temple Meads, and immediately contiguous to the Floating Harbour. They have also secured ground for a City Station Booking Office in this city (London), just opposite the Bank of England in Princes Street, and have contracted for the erection of the necessary buildings thereon, which, from the plan we have seen, are likely to do justice to the site, and to correspond with the character of the adjacent public buildings. The Directors have been rather brisk in their calls, 20*l.* per share being now paid, but the proprietary have shown their confidence in the work by responding to the demands made upon them with great readiness. The next half-yearly meeting of the Company will be held at Bristol on the 25th August, during the visit to Bristol of the British Association, and which coincidence, we trust, will lead to some interesting discussions among the scientific men then assembled, as to the merits of railways in general.

RAILWAY NOTICES.

Boston and Nottingham Railway.—The projected railroad from Boston to Nottingham appears to be a decided favourite with the public, as it will be a means of conferring immense advantages on the line through which it passes, and will not do injury to any class.

The Brandling Junction Railway has been commenced at a

point between Heworth and the Felling, and is expected to be vigorously prosecuted to completion.

Brighton.—Surely there must be something uncommonly inviting, in either its atmosphere, its water, its situation, or in "the good things of this life" which it contains, to attract the scientific exertions of so many wise men of the age, in planning and scheming an engine railway to this place. We understand another scheme is immediately to be brought forward, founded on surveys taken in 1823 (on which a Report was published), by a person who, like *Stevenson and Rennie*, competes for the honour of originating that great work, the Liverpool and Manchester Railway. The Lords may not only have done much good by affording the public the choice of another line to Brighton, but the mystery of this point of history will, in all probability, be cleared up, and the real author of the Liverpool and Manchester Railway receive the reward and the honour of his labours. It is moreover very singular, that these competitors should each have been engaged in this line to Brighton.

Brighton Railway.—After the most costly and prolonged contest in the two Houses, and upwards of eighty days in Committees, Stevenson's line of railway has followed the fate of Rennie's, Cundy's, and Gibb's, and was thrown out in the Lords' Committee by a majority of 17 to 8 peers. The resolution which disposed of it was as follows:—"That it is inexpedient to proceed further with this Bill during the present session." The minority was—Richmond, Ducie, Portland, Strafford, Queensberry, Glengall, Beaufort, and Westmoreland. The majority—Cumberland, Verulam, Warwick, Bayning, Monson, Mountford, Wynford, Redesdale, Lake, Strangford, De Lisle, Abingdon, Gage, Clanricarde, Teynham, Exmouth, and Berwick. Two only of the minority, and four of the majority, voted without hearing the discussion or evidence. The decision, therefore, as regards attendance, was *bona-fide*. The principal reasons for rejection, were the decided objections of the great majority of the inhabitants of Brighton to Stevenson's line, and preponderance in the Lords' Committee of the Brighton Junction Railway, a line uniting Brighton with the London and Dover (South Eastern) at Oxted, a cutting of not more than thirty miles. The announcement of the result at the Stock Exchange was received with three loud cheers. The contest is reputed to have cost upwards of 100,000*l.*, and to have been remarkably profitable to the legal profession.—*Morning Paper.*

Bristol and Exeter Railway.—The Directors of this great work are said to be using the most active measures for the prosecution of the work.

Railroad and Steam Communication between London and Dublin.—Great efforts are making to secure the shortest and best line of communication between the capitals of England and Ireland. A considerable difference of opinion exists as to the best route and best harbour; and at present nothing seems to be fixed

on. We hope no plan will be hastily adopted, but when a thoroughly good line is found we shall be happy to see it proceed at a truly railroad speed.

The Dover South-eastern Line.—The Directors of this line have already commenced operations near Oxted. We are glad to hear this; it looks like business. We are however sorry, but not surprised to hear, that they find it needful to apply to Parliament next session to amend their line between London and Oxted, it being said that the line granted by Parliament is either such as could not be executed, or such as if executed could not be worked to any profit or advantage. The demerits of the proposed line were strongly pointed out by the Editor of this journal and other writers in it during the progress of the bill, and we now allude to these facts, not with intent to throw odium on the Directors, who we know nothing to the contrary but are honest upright men, and who, we think, are acting praiseworthily in exhibiting so prompt a disposition to abandon their prejudices, but we allude to them for the purpose of showing the inefficient—we were almost going to say infamous—manner in which these bills are wormed through committees. If members of Parliament will undertake to legislate on subjects on which they are ill informed, or will go into the demerits of lines with a bandage put over their eyes and cotton in their ears, by interest or the twaddle of counsel, they will inflict an evil on the country not easily eradicated, and entail a curse on their posterity, as well as contribute to rob the present generation of immense sums which can never be repaid.

Fifty thousand pounds, we have reason to believe, is a very moderate estimate of the expenditure of this and the rival companies before the bill was obtained. We ask—if the line is so bad that another must be had—where is the *cui bono* of this extravagant expenditure? What has it all purchased, a simple yes to do an impossibility or an absurdity? Who is then to blame for permitting this, but the Committee of the House of Commons in the first instance, and of the Lords in the second? and what does it prove, but that committees are not fit places for the investigation of such projects?

Effect of Railways.—We have often predicted the consequence of railway communications in England, and we perceive, with no little satisfaction, that those predictions are beginning to be verified. Every body knows that a railway is now forming from the harbour of Wyre to the town of Preston, and that at the former place a town will soon arise with the name of "*New Liverpool.*" The port of Wyre is 30 miles from Liverpool; it is easily made, perfectly safe, without bar or shifting sand, and within commodious, and sheltered from every wind. The difference in the respective port-charges of Liverpool and New Liverpool, are very considerable. The following account of dues at each port may be relied on, and are calculated on an American vessel of 300 tons, making two voyages in a year, viz.:—

	£.	s.	d.
Liverpool	224	19	0
New Liverpool	11	5	0

Grand Junction Railway.—This vast undertaking, which is to unite Liverpool and Manchester with Birmingham, is proceeding with great rapidity towards its completion. The men are at work day and night, and the eminent engineer (Mr. Locke), to whose talents the work has been entrusted, has it in contemplation to throw open the line for the purpose of travelling in the course of next summer. Great preparations are also making in the carriage department, fifteen splendid ones having already been completed at the manufactory at Liverpool, and forwarded to the depot at Warrington.

London and Greenwich Railway.—Kingsford and Co. v. *the London and Greenwich Railway Company.*—Application was again made herein to the Lord Chancellor, for an injunction against the above Company, to restrain their proceeding with the bridge erecting over the river Ravensbourne, on the ground that it interfered with the navigation of the river; but his Lordship being of opinion that the Company were erecting the bridge in conformity to the Act of Parliament, very properly refused to grant the injunction. How vexatious are these unwise attempts to frustrate a great public measure!

The London and Greenwich Railway Company are about to erect a triumphal arch at the London end: our third number contained a plate of it. The motto is to be "*Vires acquirit eundo.*"

Leeds and Selby Railway.—The annual meeting of the shareholders in this undertaking was held at the Railway Office, on Friday, 29th July. The report of the Directors stated that they had not yet been able to surmount all the difficulties incident to the commencement of the undertaking, and that the expenses of working the line had been considerable, chiefly owing to a deficiency in the number of engines employed, and the difficulty of obtaining new ones, owing to the great demand. The remedy for this, however, was stated to be in progress. The maintenance of the way had also been expensive, by the subsiding of the embankments, extending to one quarter of the whole line. In the mean time, the traffic in every department is steadily on the increase, and the prospects are good. The dividend for the year was declared at 1*l.* 10*s.* 0*d.* per share.

Meeting of the Proprietors of the Manchester and Liverpool Railway, Liverpool, July 27.—This day a special general meeting of the proprietors of the Manchester and Liverpool Railway, convened by public advertisement, was held in the Cotton Sale Rooms of this town, Mr. Charles Lawrence, one of the Directors of the Company, in the chair, for the purpose of declaring a dividend out of the clear profits of the undertaking, making order for raising money amongst the proprietors, or by the admission of other persons as subscribers; and for laying before the Company a plan for

raising the sum of 427,500*l.* to discharge the mortgage debt of the Company, by creating 7968 new shares of 50*l.* each; to receive the half-yearly report, and to transact other general business of the Company. The report was read by Mr. Booth, the Treasurer, from which it appeared that in calculating the receipts and disbursements of the last half year, to the 30th of June, there had been a progressive increase in every department of the Company's business. The receipts from the coach passengers had been 57,914*l.*; for merchandise, 47,441*l.*; and for coals, 4,000*l.*; making the total receipts of the six months, 109,355*l.* The expenses during the same period were—for bad debts, 233*l.*; coach expenses, 10,202*l.*; carrying, 10,463*l.*; Directors' expenses, 309*l.*; interest, 6,681*l.*; engines, 20,425*l.*; police, 1,157*l.*; and other charges too numerous to particularize, amounting in the whole to 69,953*l.*; leaving a net profit of 39,402*l.* The report stated that the expense of locomotive power had been considerably increased in consequence of some accidents having occurred to the luggage waggons, and in consequence of the strike of the locomotive engine men. With respect to the Grand Junction Canal Company, to which the report adverted, as being about to connect the Birmingham with the Manchester line and the Northern line, it was considered that that new company would bring a great increase of business to the Manchester and Liverpool line, and that the Directors of the latter company had laid new rails on a considerable part of the road, the expense of which had no doubt been much enhanced in consequence of the present high price of iron. The new tunnel line at Liverpool would be opened for public business on the 15th of August next, and this new means of approach to the railway would prove of great public accommodation. The expense of erecting this station, and the one at Edgehill, which are constructed on a most magnificent scale, it was stated amounted to about 150,000*l.* The Directors also intended to erect a commodious station in Manchester, similar to the one in Liverpool, and with that view extensive premises have been purchased in the neighbourhood of Water Street, near the river Irwell. An additional line of carriages, which now leave Liverpool and Manchester at 7 o'clock each evening, had been found of great utility and convenience to the public. The mortgage debt of the Company, it appeared from the statements made, amounted to 427,500*l.*, to pay off which, it was recommended to create 7,968 new shares of 50*l.* each, which were to be offered to the proprietors of 100*l.* shares, and to be paid by instalments—to wit, 10*l.* on each share on the 10th of February and the 10th of August, 1837; 5*l.* on the 10th of February and the 10th of August, 1838; 5*l.* on the 10th of February and 10th of August, 1839; and 10*l.* on the 10th of February, 1840: a dividend to be payable on these 50*l.* shares in proportion to the amount of the instalments paid. The net revenue for the last six months was, 39,402*l.* 2*s.* 7*d.*, to add to which, there was a surplus of 1,569*l.* 7*s.* 7*d.* Out of these sums it was proposed to pay a dividend of 5*l.* per cent. for the half year, which would leave a balance of 1,227*l.* 15*s.* 2*d.*,

to be carried to the next half year's account. This last announcement was received by the assembled proprietors with loud cheers. From the questions that were put by some of the proprietors to the Chairman, it appears that it is the intention of the Directors to dispose of the new shares in the market at the best price. A dividend of 5*l.* per share was subsequently agreed to be paid on the 8th of August next.—*Times.*

We regret to hear that this Company have discontinued the publication of their Half Yearly Reports.—*Ed.*

The Great North of England Railway.—The Directors of this great national work were chosen on Wednesday last. There is, we hear, a determination to proceed with the construction of this important railway promptly and vigorously. A resolution has also been passed to apply, in the ensuing session, for an act of Parliament to complete the line from Croft to York, so as to perfect the communication between Newcastle and London. The number of Directors is eighteen, and they are to be paid eighteen guineas a-week for their attendance.

Northern and Eastern Railway.—The first general meeting of the proprietors of this railway was held on Friday, the 12th August, at the City of London Tavern, John Bagshaw, Esq., M.P., in the Chair. The Secretary read the report, which stated that the net profit would amount to 16*l.* per cent., and that the works would be commenced without delay, and completed within two years. The line from London to Waltham Cross would be completed within a year after possession was obtained of the land; and the whole distance to Cambridge within two years.

North Union Railway.—The annual general meeting of the proprietors of this undertaking was lately held at the Company's offices in Liverpool. By the Directors' report, it appears that there are upwards of nine hundred men employed between Wigan and Preston, and that, generally, the works are progressing with unexampled rapidity; especially the magnificent bridge over the Ribble, a structure which the county may be justly proud of. It will be exactly the Waterloo-bridge, but with only five arches. These will be 120 feet span, and are in a state that renders completion by the spring of 1838 almost a matter of certainty.

Pneumatic Railway.—We understand that Mr. Pinkers has commenced operations on the formation of a line of the Pneumatic Railway, near the banks of the Kensington Canal,—that the engines and machinery are in a forward state of completion, and that Mr. P. expects to be able, within two months, to demonstrate his method of constructing and working a line of railway.

Railroad Iron.—Bills have been obtained this session of Parliament for near 1,100 miles of road, requiring for rails, chains, carriages, and other works, at least 220,000 tons of iron, independently of that required for roads, for which Bills have been previously obtained, and are now in active preparation; these will amount to about 70,000 tons, making a total of 290,000 tons, probably in requisition for the next four years. Railroads in the

United States, either actually under contract or in progress of being surveyed, amount to more than 3,000 miles; each yard of rails weighs sixty-two and a half pounds; consequently, to lay a double line, this distance, will take 750,000 tons of iron. The whole of this iron must be taken from the British market!

Southampton Railway.—At several points between Winchester and Southampton, the railway is proceeding with as much rapidity as the nature of the work will permit. Considerable progress is making in the rising ground to the westward of the King's House Barracks, where extensive alterations are to be effected. The principal excavation in hand is below Shawford, about four miles from this city, between which and Compton the quantity of earth to be removed is immense. It has been estimated, with tolerable accuracy, that the excavation between Winchester and Southampton will exceed 1,200,000 cubic yards, the whole of which is to be accomplished by the spring of 1839. Similar activity has been displayed on the line near London, the excavation over Wandsworth Common being completed, and is rapidly approaching the terminus near Vauxhall-bridge. The great chalk embankment for the Southampton Railroad between Basingstoke and Odihampton proceeds rapidly; the bridge over the canal is completed, as well as another; the elevation of this portion of the road above the level of the valley is from 80 to 100 feet.

FOREIGN RAILROADS.

Altona and Lubeck Railway.—By the letters from Hamburgh it appears that the projectors of the Altona and Lubeck Railway have not yet brought to a close their negotiation with the Danish Government for carrying it into effect, but they do not despair of success. An extract from one of the letters well exposes the execrable state of the present road—the worst in Europe, and gives at the same time an amusing specimen of Royal impatience; it says,—"The Grand Duke Michael, of Russia, coming the other day from Lubeck to our place, insisted in making his way in six hours, whatever the number of horses required might be. Though he submitted to leaving his own equipage behind, taking a light vehicle called a 'stool waggon,' it took him full seven hours, and he arrived here terribly shaken and fatigued, and sadly complaining."—*Times.*

Railroads in Egypt.—A letter from Mr. Waghorn, dated Alexandria, July 1st, says, "The Suez Railroad is not yet commenced. Mr. Richard Galloway is occupied by the Pasha in laying down two railroads from some stone quarries near the Marabout side of the harbour to the water's edge, for the easier transport of stone for the works now in progress.

American Railways.—The formation of railroads in various parts of the United States is progressing in a manner which outstrips any similar undertaking in this country. A line of railway from Newark to New Brunswick was opened during the middle of last month, with appropriate ceremonies. The only

link which now remains to be supplied in the chain of railroad communication between New York and Philadelphia is the distance between New York and Fenton; when this slip is completed the two former important places will be within *five* hours' ride of each other, and the distance from New York to Washington will be reduced to thirteen hours'.—*Public Ledger*.

Two Oceans within Fourteen Hours' sail!—The Atlantic and Pacific Ocean are likely to be united by *Yankee* enterprise. The Congress of New Grenada has granted to Mr. Charles Biddle and others the exclusive privilege for fifty years, under the name of the "Transportation Company of the Atlantic and Pacific Oceans," to navigate the river Chagres, with steam. A further exclusive privilege, for the same period is granted to Mr. Biddle for the transportation of goods and passengers, by the railway Macadamised road, from the head of the Chagres to the city of Panama, reserving to the public a transportation road for horses and mules. Extensive concessions of land are made to Mr. Biddle in the same decree, in which colonies of natives and foreigners may be settled, and be exempted from certain contributions for twenty years. One of the last provisions of the decree ordains that if two steam-boats, at least, are not kept in operation, and that the communications are not kept constantly in such a state (excepting accidents) as to admit of the *transportation between the Atlantic and Pacific being effected in fourteen hours*, the exclusive privilege is to be forfeited.—*New York Paper*.

We have seen a letter from New York, of the 8th ult., which states that an agent has been sent to Liverpool, by the Savannah and Maeen Railroad Company, for the purpose of engaging 1,000 labourers to work on that undertaking, and that most liberal offers, together with payment of their passage, are to be made to these poor persons. The undertaking in question is to extend from Savannah, upon the Atlantic upwards of 200 miles into the interior, to the town of Maeen, at the head of steam-boat navigation in the Ocmulgee river, and the object of the latter is to demonstrate that the scheme is a most visionary and ill-founded one; that the work in such a climate and soil is so detrimental to health, that none of the native labourers will engage in it, and consequently that the propositions in question, however attractive they may seem, ought not to be entertained by poor persons in England, inasmuch as by trying to escape from one evil they may be transported to a worse. It certainly appears highly improbable, if all was quite right, that labourers for such a work could not be found on the spot, without the trouble and expense of sending over the Atlantic for the purpose, and just suspicion therefore attaches to the whole proceeding.—*Times*.

PARLIAMENTARY PROCEEDINGS ON RAILWAYS.

LIST OF RAILWAY BILLS PASSED THIS SESSION.

The bills passed during the present session, either as new or amended bills, amount to thirty-five.

Arbroath and Forfar Railway.—Great Western.—Birmingham and Gloucester.—Birmingham and Derby.—Ulster.—Dundee and Arbroath.—Hull and Selby.—Bristol and Exeter.—Sheffield and Rotherham.—Cheltenham and Great Western.—Bolton and Leigh.—London Grand Junction.—Aylesbury.—Hayle.—Bristol and Thames Junction.—Brandling Junction.—North Midland.—York and North Midland.—Manchester, &c.—Dundee and Newtyle.—North of England.—North Shields.—Merthyr Tydvil and Cardiff.—London and Dover South-Eastern.—Midland Counties.—London and Cambridge.—Deptford Pier Junction.—Edinburgh, Leith, and Newhaven.—Eastern Counties.—Preston and Longrigde.—London and Croydon.—Blackwall and Commercial.—Tremoutha Harbour and Railway.—Drogheda.—Edinburgh, Leith, &c.

The Bills thrown out in the Lords are three— Stevenson's Brighton.—Manchester and Chester.—South Durham.

NEW REGULATIONS OF THE LORDS WITH RESPECT TO RAILWAY BILLS.

NEW STANDING ORDERS WITH REGARD TO RAILWAY BILLS.

1. THAT at the Commencement of every session of Parliament a Standing Order Committee shall be appointed, consisting of forty Lords, besides the Chairman of the Committees of the House of Lords, who shall be always Chairman of such Standing Order Committee.

2. That three of the Lords so appointed, including the Chairman, shall be a quorum.

3. That previous to the second reading of any private bill relating to railways in the House such bill shall be referred to the Standing Order Committee, before which the compliance with the standing orders relative to notices, to the depositing of plans and sections and books of reference, lists and estimates, and to applications for the consent of the owners and occupiers of lands, and to any other matter which may be required by the standing orders to be done by the parties promoting such bill previous to the second reading of such bill, shall be proved.

4. That any parties shall be at liberty to appear and to be heard by themselves, their agents and witnesses, upon any petition which may be referred to the Committee, complaining of a noncompliance with the standing orders, provided the matter complained of be specifically stated in such petition.

5. That such Committee shall report whether the standing orders have been complied with; and if it shall appear to the Committee that they have not been complied with, they shall state the facts upon which their decision is founded, and any special circumstances

connected with the case, and also their opinion as to the propriety of dispensing with any of the standing orders in such case.

6. That three clear days' notice be given of the meeting of such Committee.

7. That no Committee on any private bill relating to railways shall have power to examine into the compliance with the standing orders in any of the matters upon which an inquiry is directed to be made by the Standing Order Committee.

8. That no private bill relating to railways, which shall have been opposed, in which any amendments have been made, other than verbal amendments in the Committee, shall be read a third time unless such bill shall have been previously reprinted as amended.

PROPOSED AMENDED STANDING ORDERS WITH REGARD TO RAILWAY BILLS FOR SUBSEQUENT SESSIONS.

1. THAT when any application is intended to be made to Parliament for leave to bring in a bill for making any railway, or for varying, extending, or enlarging any railway already authorised to be made, or for continuing or amending any act passed for any of those purposes, or for the alteration of the existing tolls, rates, or duties upon any such railway, notices of such intended application be given.

2. That such notices, except as hereinafter mentioned, do contain the names of the parishes and townships and extra-parochial places, from, in, through, and into which any such railway is intended to be made, varied, extended, or enlarged; and if an alteration in any existing tolls, rates, or duties is intended to be proposed, the intention of proposing such alteration be expressed therein. But in case any such bill shall be for the purpose only of altering any existing tolls, rates, or duties, or of continuing or amending any former act, and solely for the purpose of tolls, it shall not be necessary to insert in such notices the names of the several parishes and townships and extra-parochial places.

3. That such notices be inserted in the *London Gazette* twice in the month of February, and twice in the month of March of the year immediately preceding that in which such application is intended to be made, and also in some one and the same newspaper of every county in or through which any such railway is intended to be made;* or in which such railway already authorised to be made is intended to be varied, extended, or enlarged, or if there is no such paper printed therein respectively then in the newspaper of some county adjoining thereto. But in case any such bill shall be for the purpose only of altering any existing tolls, rates, or duties, or of continuing or amending any former act, such notices shall be inserted in the *London Gazette* three times in the months of August, September, October, and November, or either of them, immediately preceding the session of Parliament in which such

* For the next session it must be inserted three times in the months of August, September, October, and November.

application is intended to be made, and also in some one and the same newspaper of every county in or through which any such railway is authorised to be made, or if there is no such paper printed therein, then in the newspaper of some county adjoining thereto.

4. That a map or plan and section of the whole of such intended railway, and also of any intended variation, extension, or enlargement of any railway authorized to be made, upon a scale of not less than four inches to a mile, shall be deposited for public inspection at the office of the clerk of the peace of every county, riding, or division, in or through which such railway, or such variation, extension, or enlargement, is intended to be made, on or before the 1st day of March* in the year immediately preceding that in which such application is intended to be made, which map or plan shall describe the line of such intended railway, or of such intended variation, extension, or enlargement, and the lands in or through which the same is intended to be made, together with a book of reference, containing a list of the names of the owners or reputed owners, lessees, or reputed lessees and occupiers of such lands respectively; and where such railway, or such variation, extension, or enlargement is intended to pass through any buildings, yards, court-yards, or land within the curtilage of any building, or through any ground cultivated as gardens, an additional plan of such buildings, yards, land, and ground, and of the said railway, shall be laid down upon a scale of not less than a quarter of an inch to every one hundred feet.

5. That such section shall be drawn to the same horizontal scale as the plan, and to a vertical scale of not less than one inch to every 100 feet, and shall show the surface of the ground in the line of railway marked on the plan, and shall also have marked on it a line showing the railway line when finished (which line shall correspond with the upper surface of the rails), and a datum horizontal line, which datum line shall be the same throughout the whole length of the railway, and shall be referred to some fixed point stated on the section.

That a vertical measure from such datum line to the line of the railway shall be marked in feet and inches at each change of the gradient or inclination, and that the proportion or rate of inclination between each such change shall also be marked.

That the height of the railway over or under the surface of the ground shall be marked in figures at least twice in every mile, and also at every crossing of a turnpike-road and public carriage-road, navigable river, canal, or railway, or junction with a railway; and that it shall be stated on the section whether any and what alteration in the present level of such turnpike-road, carriage-road, river, canal, or railway is intended to be made.

That where tunnelling or arching is intended the same shall be marked both on the plan and section.

[To be continued.]

* Next session before November 30.

PRICES OF RAILWAY SHARES.

Those finished are marked (1); in progress (2); which have their Bills, but are not begun (3); in Parliament (4); not in Parliament (5).

Number of Shares.	Dividend per Ann.	Names of Railways.	Amount of Shares.	Sum paid.	Closing Price of Shares in London Markets on: July 29.	August 2.	5.	9.	12.	16.	19.	22.	26.
			£.	£.									
15,000	......	Altona and Lubeck	20	½									
2,500	......	(3)	20	1	......	......	......	......	¾	......	......	¾	
		(3)	......	5	8	......	8	7½	......	......	6¼	6⅜	6¼
9,500	......	(3)	......	5	5¼	5⅝	5¾	5⅝	5½	5½	5¾	5½	5⅝
7,500	......	(3) Birmingham, Bristol, and Thames Junction	20	1	⅞	¾	......	......	......	1	¾	¾	
15,000	......	(3) Bristol and Exeter	100	2½	2½	2½	2¼	2¼	2½	2⅜	......	2½	2¼
660	......	Calcutta and Saugur	50	2	......	......	......	......	......	......	......	......	¾
350	......	Cheltenham...........................	100										
7,500	......	(3) Cheltenham and Great Western...	100	2½	2	2	2¼	3	2¾	2½	2¾	2½	
14,000	......	(5) Cheltenham, Oxford, and Tring...	100	5	......	3							
2,000	......	(2) Clarence	100	100									
12,000	......	(3) Commercial Blackwall	50	2	......	2	1⅞	1⅞	1¾	1⅞	......	......	1⅜
8,000	......	(5) Dublin and Kilkenny	100	2½									
7,500	......	(4) Durham South-West Junction ...	20	3									
60,000	......	(3) Eastern Counties	25	1	¾	⅞	⅞	⅞	⅞	⅞	⅝	⅝	1
		Edinburgh and Dunbar	......	2									
5,000	......	(3) Edinburgh, Leith, and Newhaven	20	1									
13,000	......	(5) Edinburgh and Glasgow............	50	2	......	3¾	3⅞	......	4				
2,500	19s.	Forest of Dean	50										

800	......		Durham Junction	100	10									
2,800	......	(4)	Glasgow and Falkirk Junction ...	50	3									
		(2)	Grand Junction	100	50	......	......	......	......	......	......	......	141	
		(3)	Great North of England...........	......	2	1	1 1/8	1 1/2	1	1	1/8	......	1/2	1/2
		(5)	Great Northern	100	2									
25,000	......	(2)	Great Western	100	20	39	40	39	39	38 1/2	38 1/2	38	37 1/2	37 3/4
2,000	......	(2)	Hartlepool	100	100									
2,100	......	(3)	Hull and Selby	50	5	5	4 1/4	4 1/2	......	4	4	4 1/4	4	
10,000	......	(3)	Leeds and Manchester	100	5	24 1/4	24 1/2	......	......	18 1/2	18	18 1/2		
7,000	......	(1)	Leeds and Selby	100										
1,500	......	(1)	Leicester and Swanington	50	50									
5,100	10*l.* per c.	(1)	Liverpool and Manchester	100	100	......	......	......	......	......	......	285		
			Ditto, 1/4 shares	25	25									
10,000	......	(4)	London and Brighton (Stevenson's)	100	5	12	5	3 1/2	4 1/4	4 1/2	6	6	6 1/2	7 1/4
45,000	......	(5)	———— (Gibbs) ...	20	1	......	3/4	3/4	......	5/8	......	3/4		
16,000	......	(5)	———— (Rennie)....	50	2	......	1	1	1	7/8	7/8	3/4	7/8	
8,000	......	(5)	———— (Cundy)	100	2	5/8	1 1/8	1	1	1	1/2	5/8	7/8	7/8
12,000	......		London and Blackwall	50	3	2 5/8	......	......	2 1/2	2 5/8	2 7/8			
		(5)	London and Dover	50	1	......								
30,000	......	(5)	London and Gravesend	20	1	......	......	1/2	......	1/2				
20,000	3*l.* per c.	(2)	London and Greenwich	20	20	24 3/4	24 1/2	24 1/2	24 5/8	24 1/2	24 1/2	24 1/4	23 7/8	23 3/4
			Ditto, Bonds.		......									
25,000	......	(2)	London and Birmingham	100	60	131	130	132	......	130	......	......	135	
20,000	......	(2)	London and Southampton	50	25	23	22	27	27 1/2	......	27	26	25 3/4	25 1/2
7,000	......	(3)	London and Croydon	20	10	......	......	9 1/2	9 1/2	......	......	8 1/2	8	
12,000	......	(3)	London Grand Junction	50	2	1 3/4	1 7/8	......	1 3/8	1 1/4	1 3/4	1 3/8	1 3/8	1 1/4
1,000	......	(5)	Manchester and Oldham............	100	3									
10,000	......	(5)	Manchester South Union	100	2	4 1/2	3	3 1/2	3	3 1/4	3 1/4			

PRICES OF RAILWAY SHARES (Continued).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum Paid.	Closing Price of Shares in London Markets on								
					July	August							
					29.	2.	5.	9.	12.	16.	19.	22.	26.
			£.	£.									
		(3) Midland Counties	50	5	......	......	......	......	......	......	......	......	5
		(5) Margate and Ramsgate	......	2	......	......	......	......	1⅛	......			
		(3) North Midland	......	5	8⅞	9¼	9¼	9½	9½	9¾	9½	10	10¼
		(3) Northern and Eastern	100	8	2	2⅛	1¾	2⅝	3	2½	2½	2¼	2¼
2,500	......	(2) Preston and Wigan	......	20									
2,600	......	(2) Preston and Wyre	50	8	12½	13½							
4,000	......	(3) Sheffield and Rotherham	25	3⅛									
1,000	6l. per c.	(1) Stockton and Darlington	100										
1,500	......	(2) Stanhope and Tyne	100	100									
3,000	......	(5) South Durham	50	2½									
28,000	......	(3) South-Eastern and Dover	......	2	4	5¼	4½	4½	4¼	3¾	4	3¾	4¼
		(5) South Midland	50	1	⅞	¾	⅝	......	......	......	⅝		
40,000	......	(5) South-Western (Stevenson's)	50	1	......	¾	......	......	¾	¾	⅝	⅝	
9,000	......	(3) Thames Haven	50	2½	......	......	......	1¾					
6,600	......	(5) Victoria	25	1	½	⅝	⅝						
		(1) Warrington and Newton	100										
6,000	......	(3) York and North Midland	50	1	1½	1½	......	1⅛					

The above, as we have stated, are the closing prices of the day. They are the prices at the last business transactions. But it is to be understood that there is generally a difference of ¼ in the [illegible] the prices a person can sell at and those he can buy at, the former being less than the latter. The prices obviously [illegible] for the Share; and therefore the difference between them and the price paid on the Share is the premium or discount of the Share. Where there are blanks no business was done. We have carefully corrected the list of the number of Shares wherever we could; but should any errors be left we shall immediately correct them when pointed out.

THE
RAILWAY MAGAZINE;
AND
Annals of Science.

No. VIII. OCTOBER, 1836. New Series.

ON LEVELLING WITH THE BAROMETER.

By the Editor.

Finding that engineers use the barometer as an approximative method of measuring the altitudes of the interior parts of the country, I cannot probably do a greater service at this time, when surveys are actively going on, than give a simple rule or two for that purpose. I do this the more willingly, as barometric altimetry is a subject on which a few years since I bestowed great attention, and succeeded in constructing tables and inventing rules which are far simpler and, I apprehend, more accurate for great altitudes than any heretofore given. The theorem in p. 261 is that which contains the rules alluded to; but here such lofty altitudes are not wanting.

The object of engineers in using the barometer is merely for the sake of expedition in getting such approximative heights as may guide them in the most probable course for conducting their survey. As to levelling for the purpose of laying down rails the barometer is totally unfit. We may easily satisfy ourselves on this point by considering—1, that the barometer will occasionally stand at one, two, or more tenths of an inch different the same moment at places only two or three miles apart, though the actual levels of the places be the same;—2, that a single hour will sometimes occasion a difference of a quarter of an inch in its height at the same place;—3, that the places of simultaneous observation will in general be far distant;—4, that every tenth of an inch in the height of the barometer corresponds to near 91 feet of altitude in the average. There is indeed no way that we know of, for accurate levelling, equal to that of the ordinary mode when the instruments are good, and the observers competent and careful.

Notwithstanding all these disadvantages the barometer may, nevertheless, be very usefully employed both in laying out lines and in checking summit heights as taken by levelling.

For this purpose I should recommend the simultaneous use of three barometers, one at each terminus, if not too far apart, and the other at the points whose altitudes are wanted. If the termini are too widely distant, then it will be advisable to select two points whose heights, comparatively with the termini, can be readily obtained, one on one side of the summit to be observed, and the other on the contrary side. My reason for choosing two such points is, that we should be able more correctly to conclude what would be the height of a barometer under the point of observation, and hence the height of the hill, than we could from an observation at one distant place only. As it would be difficult to fix on the precise times for simultaneous observations, I should also recommend recording the heights of the barometers at each of the termini every half hour, or, at furthest, every hour during the day-time, with the corresponding temperatures of the external atmosphere, if great nicety is intended. By this means latitude would be given to the distant observer, and if he noted the time of his observation with the temperature of the atmosphere, if this be thought needful, any fluctuations in the atmospheric pressure might easily be allowed for.

In noting the height of the mercury in the barometer tube some care is necessary; for, if the mercury is rising, its surface is convex, and the line marking the close contact of the mercury with the glass is below the upper surface of the mercury, which not being so well defined, its true height is not so easily taken. On the contrary, as the mercury descends, its surface in the tube is either concave or flat, generally, I believe, the latter. Now, by leaning the barometer out of the perpendicular, and then slowly restoring it, we can always produce this concavity or flatness of surface, though we cannot so easily the convexity. If, therefore, this was done by all the observers at every observation, the line of contact with the tubes would be well defined, and could be accurately taken; and, if there be any concavity, it would be nearly the same in each, and no sensible error could arise from not exactly knowing how much it is.

This precaution some perhaps will think too refined; but one may as well use a little care, when the trouble is so trifling, as not; and, if the error to be avoided should be

only the one-thirtieth of an inch, which in my barometer it sometimes is, it will save an error of no less than 30 feet in the altitude.

If the mercurial columns in the barometers differ much in temperature, which is ascertained by the attached thermometers, in strictness they should be reduced to a common temperature; but, in such cases as those we have in hand, it will, I apprehend, seldom be necessary. I am even doubtful whether the difference of temperature of the atmosphere will produce effects equal to the probable amount of the errors of observation in such cases as we should have to deal with. This, however, I leave to the judgment of the parties; but, if it should be deemed adviseable to notice it, recourse must be had to the theorem I have given, p. 261, or to the one below.

For the purpose of getting the altitude of the hill tolerably near it, it will be needful to get the height of an imaginary barometer directly under the one observed, and in the plane of the termini. For this purpose, take the distance of the place of observation from each terminus nearly, for great accuracy is not required. *Then multiply the difference in the heights of the barometers at the termini by the distance of the place of observation from the lower barometer, and divide the product by the sum of the two distances before found. The quotient will be to be added to the height of the lower barometer to have the height of the imaginary barometer under the hill.*

Then, to find the height of the hill, *multiply the difference in inches between the height of the imaginary and real barometers by 907·5. To this sum add four-fifths multiplied by the said difference and then by ten times the difference less one, and the result will be the height in feet very nearly.*

Example.—Suppose the barometer on a hill, 50 miles from one of the termini and 60 from the other, stands at 29·25 inches, while that at the former terminus stands at 30·15, and at the latter 30·55, required the height of the hill above the plane joining the termini.

To find the height of the imaginary barometer:—

30·55	- - hence - -	30·15
30·15		·18
·40	Height	30·33 of imaginary barometer.
50		29.25
110) 20·0(·18		1·08 difference.

Again,

$$907{\cdot}5 \times 1{\cdot}08 = 980{\cdot}1$$
$$\frac{4}{5} \times 1{\cdot}08 \times 9{\cdot}8 = 8{\cdot}5$$
$$\overline{988{\cdot}6} \text{ feet altitude sought.}$$

Altitudes so high as this are very seldom wanted in railway surveys, and in general the correction, or latter part, might be omitted. Indeed, unless we have very excellent instruments and very good observers, it would be a waste of time to attempt to go nearer. It is on account of the uncertainty to which observations of this sort are liable that I do not think it worth while to present my readers with the tables I have long had by me for the purposes of barometric altimetry.

That nothing, however, may be wanting I shall here give a theorem, derived from mine in p. 261, exceedingly well adapted to logarithmic computation. It gives, as before, the altitude in feet and includes the temperatures of the air at the higher and lower barometer. Suppose F, f, be the Fahr. temperatures at the higher and lower stations each augmented by 448°, and let Δ be the difference between the two barometers, and b be the height of the upper in station, then the altitude in feet is very nearly, if under 1000 feet,

$$\frac{1087\,\Delta\,F\,f}{b\,(F+f)}$$

If $F = 54° + 448 = 502$ and $f = 50 + 448 = 498$, the altitude in the foregoing example, will come out 998·7 feet, that is, only 10 feet above the preceding calculation.

EXTRACT FROM A PRIVATE LETTER RESPECTING RAILWAYS IN GERMANY.

We have been favoured with the following extract from a private letter from Emilius Muller, Esq., General Continental Agent to the Altona-Lubeck, &c. Companies, to J. Y. Ackerman, Esq., which we willingly lay before our readers.—Ed.

The sense for railways has of late made rapid strides in Germany.

The Nurnbergh and Furth Railroad conveys regularly

12,000 passengers per week; the shares of 100 florins stand now 380 florins.

The Leipsic and Dresden Railroad will be partly opened in the next month, and soon be connected with the Munich and Augsburgh Railroad, which again, will in some years be extended to Trieste on the Mediterranean.

The subscription list for a railway from Magdeburgh to Leipsic, (capital three millions dollars,) was filled up in two days, and in a similar manner closed the subscription for the railroad projected to join the river Rhine with the Weser, by a line from Cologne to Minden in Westphalia.

I am personally engaged in forming a company to carry into effect a railway between Hamburgh, Berlin, and Magdeburgh, (length 250 English miles,) uniting three large towns of 500,000 inhabitants, whose export and import trade amounts to several hundred thousand tons per annum. The soil is generally flat and of little value.

The more the subject of railways is examined and understood in Germany, the more it becomes evident, that the central position of Germany, the flatness and cheapness of the soil, materials, and labourage, and the scarcity of canals and macadamized roads, as well as the nature of the trade, form many encouragements for railway speculators, which do not exist in England.

A LETTER TO JACOB PERKINS, ESQ., ON SOME CURIOUS EXPERIMENTS MADE BY HIM.

London, June 18th, 1836.

My Dear Sir,

In compliance with your request, I have looked over your critique upon the experiments made by the Committee of the Franklin Institute upon the explosion of steam boilers.

From my numerous observations of your experiments upon steam from ten to upwards of one hundred atmospheres of pressure, as well as by my own researches since made, I am enabled to concur with you in your views of the fallacy of some of the experiments detailed in the Franklin Journal on that subject.

I hope before many months to return to Philadelphia, when, if the Committee has not terminated its labours, I shall suggest some modes of conducting the experiments with perfect security, and better calculated to obtain satis-

factory results than those already recorded in the numbers of the Franklin Journal which have arrived in England.

Among the number of interesting facts which your experiments elicited, I clearly recollect one which satisfied me of the repulsive power of heat against water when opposed to each other at narrow apertures.

I allude to the case of one of your generators, in which was a fissure about four inches long, which generally allowed water enough to drop through to damp that part of the fire immediately under it, whenever the stoker neglected to keep the fire particularly strong at that point, as you directed him.

This generator was a wrought-iron cylinder placed horizontally, of about six inches internal diameter and about four feet long, terminated by hemispherical ends, the thickness throughout being about an inch and a quarter; the bottom of the generator was placed about six inches above the fire-bars.

When you first called my attention to the state of it, you shewed me a strong glowing fire under the whole length of the generator, desiring me to observe that no water dropped from the fissure, and that the steam gauge indicated about seventy atmospheres. You then raked away that part of the fire immediately under the fissure, and in a few seconds the water began to drop from it, and shortly afterwards it ran in a fine stream.

You again raked a quantity of glowing coals around the stream, and nearly close up to the generator; the stream soon lessened, and in a few minutes ceased entirely, as also did the succeeding drops, and the generator continued without leakage, so long as the strong fire was kept under the fissure; the experiment was repeated several times, and always with the same result.

I recollect on another occasion standing with two scientific friends in your engine-room explaining the action of the engine. I had just shewn them the steam guage, and read off to them that the index then pointed to 1600 lbs. pressure on the square inch.

Upon their expressing apprehension of danger, I assured them of my perfect confidence in our security; their incredulity, however, did not appear to be diminished.

It is curious that at that moment a burst of the generator took place, making a fissure through which the steam rushed with a very loud noise; my friends ran into the yard in great terror, while I sprung to the generator, closely to observe the issuing stream.

After all was over my friends said, that my involuntary impulsive spring to the scene of supposed danger, was the strongest possible proof to them of my perfect confidence in the safety of the generator.

I remain, my dear Sir, yours very sincerly,

JOHN ISAAC HAWKINS.

To Jacob Perkins, Esq.

THE ORIGINAL PROJECTOR OF THE LIVERPOOL AND MANCHESTER RAILWAY.

IN accordance with the spirit of our Magazine to notice every subject relating to railways, we offer to our readers' perusal Mr. James's petition to the House of Lords, which, just before the prorogation of Parliament, was presented by Earl Ripon, and another of a similar nature to the Commons, by John Wilks, Esq., M.P.

We are not acquainted with the particular grounds of his complaint, nor shall we inquire into his motives for remaining so long in silence and in the shade, but we cannot refrain from observing, that if it should prove to be the fact (and we do not dispute it) that he invented the improved railway system, was a partner in the Locomotive Engine Patent, and introduced *both* to public notice, by originating, surveying, and planning the Liverpool and Manchester Railway, he must be a person of rather a peculiar character, to suffer all the gain and profit as an individual, all the honour and glory as an engineer to be taken from him, whilst every other engineer has been ambitious to obtain even a feather of distinction, from having been in the slightest way connected with this very successful undertaking. The causes and motives for this extraordinary forbearance we shall be curious to ascertain, that justice at least may be done to his pretensions by an impartial public.

We quite agree with Mr. James in the miserable protection afforded to inventors and discoverers, but we look for better times.

To the Lords Spiritual and Temporal of the United Kingdom of Great Britain and Ireland in Parliament assembled.

The humble petition of William James, of Bodmin, in the county of Cornwall, and of the city of Westminster, Engineer and Land Agent:—

Sheweth,—That your petitioner is upwards of sixty years of age, and for more than the last forty years of his life has been very extensively engaged in draining lands, opening mines, forming railroads, commons, roads, and canals, and generally in improving the country, and contributing to its wealth and importance.

That in the year 1816, and during several of the following years, the value of the landed property, and especially of mines and iron works, became greatly depreciated; in consequence, being himself at that time a considerable landed proprietor, and an extensive miner and iron master, and chairman of the miners at Westbromwich, in Staffordshire, your petitioner, in order to improve the value of land, to aid in the consumption of manufactures, and especially to benefit the mining interests, personally inspected nearly the whole of the railroads then in existence; projected and gratuitously surveyed and prepared plans, &c., of other railroads, and particularly of the great Liverpool and Manchester Railroad, which, with many of the rest, were afterwards carried into execution.

That in the year 1822, your petitioner became a joint proprietor of the patent for locomotive engines for railroads, with Messrs. George Stephenson and William Losh.

That during the time your petitioner was employed in inventing, improving, and carrying into execution various engines, plans, systems, and works, he has expended upwards of 10,000*l*., for which he has never received the least remuneration or compensation.

That in addition to the loss of his money and time, he has had the mortification of seeing other persons taking up and adopting his inventions, plans, and sections, and obtaining that credit and profit from his discoveries and labours to which he of right was exclusively entitled; and that in consequence he was deterred from any further continuance of his scientific exertions, so much so, that he does not now think it prudent to forward two important discoveries and inventions by which the public might be greatly benefited, from the apprehension of being deprived not only of compensation and credit for his ingenuity and perseverance, but also for his outlay in plans, models, and other incidental expenses.

That your petitioner has no doubt many other engineers and men of science are equally deterred from inventing, promoting, and publishing schemes for lessening labour and otherwise advancing the great works now in contemplation throughout the kingdom.

That your petitioner humbly represents to your Right Honourable House the great national good that will arise from lightening the labour, lessening the expenses, obviating the difficulties, preventing the dangers, and increasing the facilities for the completion of those great works, to which the Legislature has given its sanction.

That the chief cause of the discouragement now existing to the

promotion of scientific discoveries consists in the inadequate protection afforded by the law of patents, which gives to the discoverer the monopoly of the whole of his invention, yet allows others to steal any of its parts, and thus by uniting those parts so stolen with other inventions, or with stolen portions of other patents, to mock the law and laugh at the claims of other original inventors.

That your Right Honourable House has recognised and protected literary property, by the law of copyright, in a much more efficient manner, and providing not only against the piracy of the whole, but also against the abstraction of any of its parts.

Your petitioner, therefore, humbly prays that your Right Honourable House will take into consideration the present inadequate protection to scientific discoveries, plans, models, and labours; and by extending the law of copyrights to the law of patents, or by awarding compensation and remuneration to the original inventors of all engines, plans, models, &c., when they are successfully appropriated by other persons to the same or other purposes, afford that encouragement to science and invention which the great railroads and other works now contemplated (from the success of your petitioner's project, the Liverpool and Manchester Railroad), imperatively call for.

And your petitioner will ever pray,

WM. JAMES.

ON CUTTING OFF STEAM AT PARTS OF A STROKE.

By John Moore, Esq.

To the Editor of the Railway Magazine.

Sir,

I beg to submit the result of an investigation of the theoretical effect produced by cutting off the steam at $\frac{1}{4}$ part of the stroke of the piston, when compared with the steam continued during its whole stroke having an uniform density.

Fig. 1, 2, 3, 4, are to represent steam piston cylinders; the numbers within the cylinders, the density of the steam; and the divisions, the respective quarters of the cylinders.

The numbers on the right hand are the time elapsed in the steam's progression from $\frac{1}{4}$ to its adjoining.

Fig. 1.

	Time.
14	14
14	14
14	14
14	14
56	56

Fig. 2.

	Time.
14	7
7	14
4·67	18·66
3·50	23·32
29·17	62·98

Fig. 3.

	Time.
28	7
14	14
9·66	18·66
7·25	23·32
58·91	62·98
14·72	

Fig. 4.

	Time.
56	7
28	14
18·67	18·66
14·01	23·32
116·67	62·98

In Fig. 1 the steam flows uninterruptedly from the boiler during the whole stroke of the piston, with the density of 14lb. per square inch, giving a power equal to 14lb. through the length of the cylinder in the time 56.

In Fig. 2 the steam is continued during one $\frac{1}{4}$ of its stroke at 14lb. density, it is then cut off, and acts expansively; in the next $\frac{1}{4}$ it is expanded into double space, and therefore at half its previous density, or 7lb.; in the next $\frac{1}{4}$ expanded $\frac{1}{3}$ more, and its density 4·67; next $\frac{1}{4}$ expanded $\frac{1}{4}$ more, and its density 3·50; the sum of these 29·17, as the cylinder is divided into $\frac{1}{4}$, so divide 29·17, and we have 7·24 as the average performance of Fig. 2. Compare 7 with density of the steam 14, as 7 is $\frac{1}{2}$ of 14, time of steam in passing 7lb. through the 1st quarter, will be the number equal to half the steam's density, or 7; in the next $\frac{1}{4}$, 14; next, 18·66; and in its last $\frac{1}{4}$, 23·32; together, 62·98; one $\frac{1}{4}$ of the sum of the density of the steam is about 7$\frac{1}{4}$lb.;

therefore 29·17 steam can take 7¼lb. through the length of the cylinder in the time 62·98.

In Fig. 3 the density of the steam is 28, the cylinder then contains ½ the quantity of steam of Fig. 1 in ¼ of its space, and when expanded into ½ its space will have the density of 14; when occupying another ¼ of the cylinder, its density will be 9·66; and when the cylinder is filled by its steam its density will be 7·25; its sum, 58·91, divided by 4, gives an average of 14·72lb. in the time 62·98, for its passage through the length of the cylinder.

In Fig. 4, the steam contained in ¼ of this cylinder is equal to the contents of Fig. 1, and, therefore, has a density of 56 when it has expanded into double its space, occupying ½ the cylinder; its elasticity or density will be reduced half, equal to 28lb.; upon its expanding ½ more its density will be 18·67, and when occupying the whole of the cylinder have a similar density as Fig. 1, using no more steam, but the cylinder of steam in Fig. 1 is equal only to 56 in the time 56, averaging 14. But in Fig. 4, the cylinder of steam in Fig. 1 produces an effect equal to 116·67lb. in the time 63, averaging 29·17, being a double weight lifted by it in a little longer time, or as 63 is to 56, or it would take 14lb., the average of the work of Fig. 1, through a similar distance to the time 31·57; but in Fig. 1 the same weight and like quantity of steam required the time 56.

In conclusion, I may observe that the beneficial effects of cutting off steam, before it has forced the piston to the bottom of the cylinder, seems to be derived from the power at the commencement being in considerable excess to the work done, or the spaces gone through, therefore the sooner you cut off the steam the greater density it must be, and proportionably stronger must be your boiler.

I am, Sir, yours respectfully,

Bristol, September 12, 1830. JOHN MOORE.

ON ENGLISH INVESTMENTS AND METROPOLITAN RAILWAYS.

By B. J., Esq.

THE mania for indiscriminate speculations has, we imagine, somewhat abated its fury, and the extraordinary and extensive losses in the Spanish funds will cool the ardour of at

least the more sober among that class of persons who are fond of speculation. To me it has always been a matter of astonishment, that persons with their senses about them should enter into such risks in foreign securities at all, at least into such as by internal or external disturbances must be reduced in value to most ruinous loss, but more particularly in such unsettled countries as Spain and Portugal. I should hope that, with such ample plans for the employment of their capital in the various projects and improvements of our own country, we have people that will seek this more legitimate and useful means of investment, when they are not only sure of a higher rate of interest, but are, at the same time, aiding to give employment to every branch of manufacture, to agriculture, and commerce; assisting in the diffusion of knowledge, and fostering the genius of the country, rather than helping to bolster up the credit of other nations, which will never look to their own internal resources so long as another Rothschild can lead, and Englishmen follow, in taking any loans they require, which will inevitably end in never being paid. In looking to the various means for the employment of capital in this country, it would be impossible to enter into any numeration of them, I can only refer to your "Railway Magazine," and, believing in very truth we take the lead in all the useful mechanical works of the country, the highest proof of the civilization and prosperity of a country is in its roads. The social communication of men, as well as their commercial existence, depends upon good and expeditious means of transit, and as the best yet discovered unquestionably is that by railways, they therefore take the lead of all the works of national usefulness, and I confess I am therefore a warm advocate of them generally. I by no means recommend capitalists, whether large or small, to embark their money indiscriminately in their formation; some must be good, some bad, many better than others. Fortunate or judicious will be those who have entered into the good; for if the profit be unshackled, as it should be, they must unquestionably pay a high rate of profit.

It is not my province to distinguish among the various lines formed, forming, or to be formed; but I do believe if the lines are judiciously chosen, and well laid out, almost every one will pay a large per centage, where the distance is sufficiently long to make a charge, and not so long as to make the expences run away with the income, which must be the case in long distances, where there are no interme-

diate stages, to make each section of the whole pay itself. The South-Eastern, for instance, depends almost exclusively on its termini, and, unless it goes to Brighton, never, I think, can pay.

The Eastern Counties' runs through a number of towns connected together, and, if there is any traffic between them, ought therefore to be profitable. The Blackwall Railway is too short to reduce expenses, or to make a saving in time. It will, therefore, save nothing in the run, nor will it give increased facilities, and, consequently, cannot increase the traffic, being dependent on that now existing to the Docks. It appears, indeed, to be too short for so great an expense in construction. The City and Richmond Railway, now in projection, would appear to meet our views in having a sufficient extent to embrace a large mass of inhabitants, always on the move backwards and forwards to some of the various points in its passage; and, as it will become the terminus in London of the different large railways in construction on the west and probably on the south, which do not themselves come beyond the outskirts of the City, it must pay, in my opinion, a very large profit, and be highly useful to the outskirts of the metropolis. The extraordinary increase in the numbers of omnibuses and other vehicles, as also that of their speed, as well as that of steam-vessels to all parts, all of which fill, is abundant proof of the public demand for increased facilities of transit, with as little trouble and as much comfort as possible. Upon that ground I point to the City and Richmond and Thames' Haven Railways as sure to pay a large profit to their subscribers, the first proposing to become the terminus to eight of the most important railways. One great feature of the former appears to be the relieving of the present crowded state of the Metropolis, including Southwark and Lambeth, from the omnibus system, which it will much help to do, and of the latter the convenience of its dock and landing-place.

I am, Sir, your obedient servant,

B. J.

GRAND MATHEMATICO RAILWAY DISCOVERY.

To the Editor of the Railway Magazine.

SIR,

It is rumoured that a splendid discovery has lately been made in the mixed mathematical sciences, of high importance to Railway Companies having tunnels and bad

gradients. It was long known that hills might be lowered, valleys raised, and a vast variety of other gigantic matters be perfected by the means of gold, but no one, it seems, thought of combining this potent metal in a general formula with mathematics and time. We understand, however, that it is now done; the discovery was commenced about three years ago, and has been very sedulously prosecuted ever since. The exact history and particulars of it we are unacquainted with, but it is said, that on placing several terms in the order of a series, each being the product of a day by five guineas, with the sign of equality on one side of them, a curious phenomenon appeared. There suddenly sprung up on the other side of the sign a group of terms, consisting of an aversion to tunnels, the destruction of vital air by locomotives, horror of particular gradients in them, darkness, damp, death, danger, with innumerable other evils to passengers; a conviction that it was better to go ever so far round than to go up a particular incline. All these terms were implicitly involved in a complex formula, and required long and toilsome calculations to elucidate, yet they were wholly comprehended in what is called a continuous function. By the side of it, however, appeared one of those troublesome subjects to mathematicians called a discontinuous function, in which it was demonstrated that though a level line was the best, a line nearly level was bad, but if it went up to the clouds and back—those who say it was to the moon we are informed misunderstood the great discoverer—it was in all respects equal to a perfectly level line.

Part of this was very intelligible to men of science, but a part of it occasioned great discussion, the principles being carefully kept a secret.

It was natural to suppose that such successful discoveries would stimulate the author to still greater exertions. On examining the expression, it was found to be one of those which vary much with a change in the radical quantity. Retaining, for instance, the same unit of time, putting 50*l.* for a governing constant, and 10*l.* or 10 guineas, instead of 5 for the daily multiplier, the terms on the other side became wonderfully changed, the negative became positive, and the positive any thing desired. Inclined planes were of so little account that no one would go out of the way to avoid them, hatred of tunnels was turned into love, carbonic acid gas and sulphur were no longer detrimental, but beneficial, perhaps changed into the exhilirating nitrous gas, locomotives in tunnels were found to diffuse a delightful

perfume, smoke gave colour to the complexion, damp prevented chapping of the skin, the noise in them was charming melody, and as to light, how could there be any want of it if they were open at both ends? Besides, if there was it would be variety, in which all charms consist, and would afford many useful opportunities.

This discovery is of such paramount importance that it cannot be too widely circulcated among railway companies, particularly those who have bad lines and weak cases.

Great interest has been excited to find out the principles of the discovery, but as yet in vain. An acute young chemist has declared that the subject is not mathematical but chemical; that the whole rationale consists in a strong solution of ignorance, precipitated by great impudence on a large area of gullibility. While some have been disputing in this way, others have been at loggerheads about the country to which it belongs. An Irishman has proved that it is not English, because no English genius at all could have been equal to it; he is quite positive it must have come direct from Dublin.

I am, Sir, your obedient Servant,
PHILO-HUMBUG.

MR. ROWLEY'S ARTIFICIAL FOUNTAINS.

By J. BINNS, Esq.

To the Editor of the Railway Magazine.

SIR,

HAVING had the honour and gratification of viewing the beautiful cottage at Windsor, belonging to Her Majesty, Queen Adelaide, which, for real taste in that style, surpasses all I have ever seen. I was struck, amongst other excellent contrivances, with an elegant and I may say superb fountain, which, for the beauty and variety of its jets, is so decidedly superior to any of the various jets-d'eau that I have had the opportunity of seeing upon the Continent or in England, that I am anxious you should see it yourself, and make it known through the medium of your valuable and scientific Magazine. I have also strongly recommended Mr. Rowley, the inventor, to consult with you upon the best means of introducing it to the notice of the truly scientific and clas-

sical admirers of which this country, I am happy to say, has now to boast. I am, Sir,

An admirer of your valuable work, and obedient servant,

J. BINNS, *a Subscriber.*

Sept. 26, 1836.

[We have seen the fountain our correspondent alludes to, in many of its varieties, and perfectly agree with him in its being one of the most beautiful we have ever seen. The plate to this number, which we have borrowed from Mr. Rowley, gives but a poor idea of it. We have been surprised it has not been more generally introduced. How much better would the worst of its forms look than that unmeaning spout of water in the Temple?—ED.]

To the Editor of the Railway Magazine.

SIR, *September* 5, 1836.

OBSERVING in your Magazine a paragraph stating that Sir John Rennie's Brighton Line of Railway is abandoned, and the Company's Establishment broken up, except one officer,* I request to be informed who was the author of that paragraph, as it is without the slightest foundation in fact, and that you will, in your next number, insert this positive contradiction of its truth.

I confidently call upon you to do this, as you have set forth to the public that you insert nothing in your Magazine but what is well authenticated.

I am, Sir, your obedient servant,

H. DEAN, *Secretary.*

The direct London and Brighton Railway Office,
3, *Chapel-place, Poultry.*

[We insert the above letter, as we shall always be ready to do when our statements are questioned. If Mr. Dean will look at the bottom of our article he will find that the Editor himself is the writer of the sentences alluded to, which, however, has no such positive meaning as Mr. Dean asserts it has. We have no desire to prejudice Sir John Rennie's line, but we can assure Mr. Dean that the rumour in question is very common in town, we have heard it a dozen times since, and coupled with much stronger circumstances than we have mentioned.—ED.]

* Our observation is, "Rumours are afloat that Sir John Rennie's Company are not likely to come again into the field. It is said they have reduced their establishment to one officer only, the Secretary."—ED.

SCIENTIFIC AND MISCELLANEOUS INTELLIGENCE.

Steam Vessel with a Mercurial Boiler.—A vessel, called the Vesta, has been plying between London and Margate, worked on the principle of Howard's vapour engine; that is, instead of a boiler, by throwing the water to be converted into steam on an iron plate, covering a quantity of mercury, kept at a high temperature. It is said she works well, and is able to cope with the most powerful steamers on the river. If this plan succeeds, it is expected two-thirds of the fuel will be saved.

Safety Steam Boilers.—It is pretty generally known that Mr. Galy-Cazalet has contrived a method of preventing the fatal effects of explosion by steam-boilers, which he has patented. His plan consists in having a tube perforating the boiler, from a little above the top to the bottom, or a little below, which is in communication with the upper, or steam part of the boiler. Through a stop-cock at the top, a mixed metal bullet is let fall into a socket near the bottom of the tube, which it fits steam-tight. While the temperature of the steam is beneath a certain point, the bullet remains, but as soon as this is surpassed the bullet melts, and the steam rushes into the fire, and quickly puts it out, or arrests its vigour. By this means the pressure in the boiler is limited to a certain extent, and the breach is instantly repaired by undoing the stop-cock, and dropping another bullet into the socket. We have not heard whether this invention has been used; the whole efficacy of it turns on the certainty of the bullet melting at a given temperature.

Machine for Raising Water, Weights, &c.—A very singular combination of machinery is exhibited at Miner's Hall, Exeter-street, Strand, for bringing up water, weights, and any produce from great depths, as mines, shafts, &c. It is impossible we could do the invention justice by any description we could give. To judge of it, it is needful to see it. The principle is that of a limited alternate motion, up or down, within certain frame-work, by means of wheels and levers at the top. A load is, by a simple and ingenious contrivance, delivered from point to point, and brought, with numberless others in succession, from any depth to the top of the shaft. By a similar contrivance, the empty or loaded baskets or buckets are successively sent down—twenty, thirty, or more, ascending and descending at the same time. Water is transferred from bucket to bucket by valves opening upwards at their bottoms. The machinery seems to be exceedingly well balanced, and does its work with comparatively little friction and the regularity of a clock. It is capable of being worked either

with a steam-engine, horse power, or the hand, and may be applied to an almost infinite variety of purposes.

Rotary Engines.—It would appear, by accounts from America, that Mr. Avery is exciting as much interest with his rotary engine, as Lord Dundonald, some time since, did with his. Mr. Avery, however, is proceeding in the safe path of practical application, and seems to be creating almost as great a sensation in Europe as he has in America. We have long been convinced that a good rotary engine is now the grand desideratum for locomotive carriages.

Schultz's Railway Carriage Spark Arrester.—The Franklin Institute of Pennsylvania have reported favourably of this invention, which consists of a sheet of wire gauze placed near the bottom of the chimney, the chimney being there enlarged to allow of sufficient draught. The steam is turned in above the gauze, which will tend to prevent the choking of it by a combination with soot, &c. The objection seems to be a fear of too rapid destruction of the gauze by the heat it is exposed to.

Railway Performance Extraordinary.—The locomotive steam-engine, George Washington, made for the State of Pennsylvania, by William Norris, of Philadelphia, was placed on the Columbia and Philadelphia railroad on Saturday afternoon, the 9th of July. On the following morning her powers were tested, in ascending the inclined plane near Philadelphia. This plane is 2,800 feet in length, with an ascent, in that distance, of 196 feet, being at the rate of 369 feet the mile, or seven feet rise in 100 feet, or one foot in thirteen. The weight of the engine is 14,930lbs. only. The load attached weighed 19,200lbs., including the weight of twenty-four persons, who were on the tender and burthen car. The engine started immediately at the base, without a running start, and dragged up the said load of 19,200lbs., the above distance of 2,800 feet, in the space of two minutes and one second, or at the rate of 14$\frac{4}{5}$ miles per hour; pressure on the boiler, a fraction under 60lbs. to the square inch. The engine then descended the plane with the same load, at various speeds, frequently stopping to test the security. The valves being reversed, or set for going a-head, and when it was desired to stop altogether, the steam was let on very slowly, which brought her to a dead stand for a second or two, when she would immediately start up the grade. In this way, stopping and starting at pleasure, the time occupied in descending the 2,800 feet, was from twelve to fifteen minutes, thus testing the perfect security of her performance on the plane. She again ascended the plane, with the same load, and took her place on the road the same morning, ready for use.—*American Railroad Journal*, July 16, 1836.

BRITISH SCIENTIFIC ASSOCIATION.

Our last number was made up, and, indeed, nearly all printed before the British Scientific Association had finished its Sixth

Annual Meeting, held at Bristol. Reports of the proceedings of that body have been so hawked about, that we cannot think of surfeiting our readers with a repetition of them here. We shall, therefore, without running through the whole of the proceedings, briefly state those on points which were either new or remarkable:—

Tides.—Mr. Lubbock stated that the tides do not obey the moon as it exists at the time, but as it existed fifty or sixty hours, or five or six transits before; and that the height of the tides was influenced by the height of the barometer. For instance, a fall of the barometer at Brest of 0·622 inches, increased the tides 8·78 inches; and at Liverpool every tenth of an inch rise or fall in the barometer, depressed or heightened the tide one inch.

Internal Temperature of the Earth.—Professors Phillips and Forbes recounted experiments to ascertain the effect of depth on the temperature. They both agreed that the temperature increased as the depth; and the rate stated in the theatre was about one degree of Fahrenheit for every fifteen yards of depth. In the open atmosphere the law of decrease is one degree for every 110 yards of altitude; so that the super and subterranean laws differ widely. We ourselves are strongly against the influence drawn by these and other gentlemen of an independent internal heat in the earth, and feel satisfied that the whole temperature of the earth and planets will be found to have been derived from the solar rays.

Phosphate and Pyrophosphate of Soda.—Mr. Watson read a paper on the Phosphate and Pyrophosphate of Soda. He said that phosphoric acid gives off water in being converted into pyrophosphoric acid, and that hydrogen and carbon are the component parts of the former; that the above two acids are different in their composition and atomic weight, phosphoric being 36·1, and pyrophosphoric acid 31·7; that the precipitate by pyrophosphate of soda and lime water is black, that by phosphate of soda and lime water white; and, finally, contrary to present opinion, that a solution of pyrophosphate of soda does not spontaneously change into phosphate.

Engraving.—Mr. Greenough mentioned a new mode in France of engraving medals, which he thought might be well employed in laying down surfaces on maps.

Climate of North America.—Dr. Richardson stated that the eastern coast of North America has a lower mean temperature than the western, at least in high latitudes; that the decrement of this mean temperature is greater for a given increase of latitude, and the difference between the summer and winter temperatures also much greater than in Europe. We believe Humboldt has noticed this before.

Malt, Sugar, and Spirits, from Mangel Wurtzel.—Mr. Rootsey produced specimens of sugar, malt, and an ardent spirit, extracted

from Mangel Wurtzel, and remarked that it was nearly as nutritive for cattle after its juice was expressed as before. He stated that ½ cwt. of malt from Mangel Wurtzel was equivalent to a bushel of common malt.

Stage Coaches and Steam Vessels.—"The first stage-coach in Scotland," says Dr. Cleland, "was, in 1678, started by William Hume, to run between Glasgow and Edinburgh, a distance of forty-two miles. It was to start from Edinburgh every Monday morning, drawn by 'six able horses,' and return, 'God willing,' every Saturday night. The fare from March 1, to September 1, was 4*l.* 16s. Scots, and from September 1, to March 1, 5*l.* 8s. Scots. The first steam-vessel was the Comet, which started in January, 1812, to ply between Glasgow and Greenock. She made five miles an hour against a head wind, and afterwards, by increasing her power, seven miles."

Turnpike Roads, even in England, are of a modern date. In the year 1739, the northern turnpike-road extended only to Grantham, 111 miles from London. Goods were transported on pack-horses, thirty or forty in a string. The leader carried a bell to give travellers in the opposite direction notice of their approach. As the track was generally a narrow causeway, with a soft road on either side, travellers who met these gangs of horses and were obliged to give way, often found it difficult to regain the causeway.

Waters' Resistance to Vessels.—It had generally been understood that the resistance followed the square of the velocities; namely, that a vessel sailing with a double velocity would encounter a quadruple resistance, with a triple velocity nine times the resistance, and so on. Experiments, however, have lately proved that this is true only up to a certain point, and if beyond this point the velocity be increased, the vessel rises somewhat out of the water, and glides along, as it were, on the surface of the water, causing thereby much less disturbance to the water, and much less resistance to the vessel. This had been found true in practice, but no one had suspected the fact to the extent Mr. Russell seems to have found it to be true. Mr. Russell has shown that the resistance varies to a certain velocity (7½ miles an hour), after the old law of the duplicate ratio of the velocities; but with an addition of one mile an hour more, the resistance fell near 20 per cent., and then increased again, we believe, indefinitely. But the most remarkable part of it is, that the same boat, and a different load (we believe a heavier), though, to 7½ miles an hour it followed the same general law, and always maintained a superiority in the amount of resistance, yet, at 8½ miles an hour, the resistance not only dropped, as in the former instance, to a minimum, but actually fell below that of the other, or lighter load. Mr. Russell gave a very ingenious explanation of the phenomena. He said, that the velocity of the wave he found independent of the form of the vessel which caused it, and equal to that a heavy body

would acquire in falling through a distance equal to a half the depth of the canal, reckoning from the top of the wave, as we understood it. This can evidently only be an approximation, because in very deep water the velocity would be excessively great, which it cannot be. Having arrived at his result, Mr. Russell perceives that, as the velocity of the vessel increases, it gains on the velocity of the wave it raises, and the resistance becomes greater; but when the vessel has overtaken the wave, it mounts, and, as it were, rides along on the top of the wave, having lost all that head resistance it had before experienced; as the velocity is farther increased, another wave is raised, and so on.

This explanation will do very well for the same vessel and load, but we cannot see how it can be applied to a different load, so as up to 7½ miles an hour to have a greater quantum of resistance, and then a sudden sink to a minimum less than the minimum of the lighter load. Neither could the editor of this Magazine learn, from the answer to a question he put to Mr. Russell, "whether the numbers given were each the mean of several experiments, or separate experiments?"

Form of a Vessel of Least Resistance.—Having attained so curious a property, Mr. Russell was naturally led to consider the form of a vessel of least resistance. Instead of the head of the solid of least resistance being, as determined by Newton and other mathematicians, Mr. Russell, partly by experiment, and partly by theory, found the plane of revolution at the prow of the vessel to be a curve of contrary flexure, made up of two parabolic arcs turned the contrary way, the axis of the parabolas being perpendicular to the longitudinal axis of the boat, and the first parabola convex to the axis; the dimensions of these parabolas we could not catch. The remaining part of the plane coincided with Newton's. By this means the prow of the vessel is sharp, and not much unlike in figure the small light boats on the river Thames. We can easily believe, independent of experiment, why such a figure should be the best; for it is that which tends most to raise the vessel in the water in swift motions, and, consequently, to make her skim along the surface with the least disturbance to it. Newton's solid was to be drawn through the midst of a fluid, and not to float at the surface, which makes all the difference. Mr. Russell's experiments, and Newton's theoretical investigation may, therefore, be perfectly reconcileable.

Electro-Magnetism.—The Rev. J. W. M'Gauley, who discussed the subject of Electro-Magnetism as a moving power, at the last meeting of the Association in Dublin, entered into a description of some experiments on the power of certain magnets. It did not appear that Mr. M'Gauley had advanced in the main parts of his invention, that is, the application as a moving agent, though he mentioned some interesting experiments on the power, &c. of magnetism. He considered the identity of magnetism and elec-

tricity as established, but he did not believe either to consist in the transmission of a fluid, but in an alteration in the arrangement of the particles of the bodies.

Immediately that Mr. M'Gauley had ceased, Dr. Ritchie got up and stated that there was not a new idea in the whole of the communication, mentioning where the various matter of the subjects was to be found. Dr. R. did not wish to charge Mr. M'Gauley with being conscious of this. "It is probable," says Dr. Ritchie, "he may have been too much absorbed in his own experiments to attend to what others had done." We have lately seen a letter from Mr. M'Gauley in reply to this, charging Dr. Ritchie and Mr. Stevelly with waiting until he had left the room, and then making "very bitter, uncalled-for, and unfounded attacks." We were present, and can say that not a moment was lost by Dr. R. in getting up, after Mr. M'Gauley had finished; we think it barely possible he could have quitted the room, and certainly we did not witness any bitterness of disposition. Dr. R. simply declared the paper contained nothing new, and pointed out the places where the matter of it was to be found, at the same time making an excuse for Mr. M'Gauley's not knowing this.

Magnetism.—The Rev. Mr. Scoresby gave an account of a very delicate instrument, which he named a magnetimeter. The instrument consisted of a small and delicate needle, placed on a brass stand, and the bar, or other body to be examined, placed on the same stand with a joint, so that it may be raised or lowered to the terrestrial magnetic equator, in which position the magnetism of the earth exercised no inductive influence on the body to be examined. Such was the delicacy of this instrument that, by rapidly drawing a piece of very soft iron once or twice through his fingers the needle instantly deflected. Mr. S. thought it might be applied to many useful practical purposes; as, for instance, to that of detecting the relative goodness of specimens of iron; for the finer and softer the iron, the more readily is its magnetism developed. Dr. Ritchie said Le Compte was the first who proposed detecting minute magnetism by a similar method. Mr. Scoresby also produced a magnet of great power by uniting with brass pins several ladies' busks, kept in the centre from touching by light pieces of wood, and in other places by pieces of card. To prevent too great a pressure on the pivot, the needle was so suspended by a piece of untwisted silk that it barely rested on the centre.

Professor Forbes related some experiments, to determine whether and how much the magnetism of the earth diminished at great altitudes. By forty-five made by himself, at from 6,000 to 10,000 feet high, in the Alps and Pyrennees; by Sanssures, at 11,000 feet high on Mont Blanc; and by that of Lussac in the balloon, 7,600 yards, or 4½ miles high, it did not appear, after due allowance was made for the fall of temperature, that any diminution existed.

Artificial Crystallization.—Mr. Cross, after several trials, had constructed an apparatus which retained its electric energy by the agency of pure water only for an entire year. He conceived it was by long continued processes nature effected most of her works, and on this view he procured some water from a cavern in the Quantock hills, where he had observed calcareous spar encrusted on limestone, and arragonite on clay, and submitted it to his Voltaic apparatus. For nine days he watched and saw nothing; but, on the tenth, when he had nearly despaired of a result, he had the delight to succeed in procuring minerals, the same as those in the cavern. Further experiments showed him that light was unfavourable to the production of crystals. We also suspect temperature will be found to have an influence. He succeeded in forming several crystals of metallic minerals; but that which pleased him most was the production of quartz from fluo silicic acid. He had also seen what perhaps mortal eye never had before, namely, the whole process of crystalline development. He had seen the quartz crystal first marked as a hexagon on the matrix, then rectilinear radiations from the centre, and, at length, lines formed parallel to its sides. But the process being by some accident disturbed, a complete crystal was not formed, and a second grew up intersecting the first, just as nature almost every where exhibits, and therefore demonstrative of the identity of Mr. Cross's process with that followed by nature.

This was justly esteemed one of the most brilliant discoveries submitted to the Association, and produced, as might have been expected, an extraordinary effect on the audience.

Railway Statistics.—Dr. Lardner endeavoured to show that railways increased travelling fourfold, and broached this startling idea, that three out of four go by railways for economy of time rather than of money. Lord Sandon could not admit that Dr. Lardner had any foundation for such deductions; and Baron Dupin opposed both his notions of anticipated "miraculous velocities," and of the reason for which the public preferred railway travelling; he could hardly believe a man who got only 5s. a-day would spend 6s. to save a day.

Principles of Locomotion.—Professor Mosely considered that the usual theories of locomotion were incorrect, inasmuch as there was a certain friction, which he termed the passive friction of the machinery, that was not taken into account. This friction he maintained was a constant quantity, and in the Manchester railroad carriages amounts to 120, 170, or 180lbs. He insisted that what the pressure of the steam had to overcome was the above constant force, another of the machinery proportional to the load, and a third the traction or friction of the train. Mr. Mosely said these results were not new, but were not generally known. He surely must have been misunderstood; they are new, and ever will be in practice. Can any one for a moment imagine, that

out of a total traction of 240lbs., which is generally that of a passenger train, 150 or 180, that is, $\frac{2}{3}$ of it should lie concealed as a constant quantity, and no one know it? Indeed, if such was the case, a train which runs on a level at about thirty miles an hour, instead of going up the inclined planes, as it now does, at eight, nine, or ten miles an hour, would fly up at the rate of twenty.

Though Mr. Mosely admitted a few may know something of the above principles, yet for the following application of them he "claimed entire novelty."

If a locomotive engine be required to ascend with its train an inclined plane, the passive friction of the machine will remain unchanged; the friction resulting from the traction will increase in the proportion in which the traction is increased; the traction will be increased by the resolved portion of the gravity in the direction of the plane, and it will be diminished, with respect to the friction of the train in proportion to the course of elevation. This diminution of friction, however, is counterbalanced by the increased distance through which the whole mass is moved; *so that its effect is the same as if the whole had traversed a horizontal plane;* and hence *the traction of the train arising from friction, and the friction of the machinery resulting from this cause, remain unaffected by the ascent.*

We think no comment will be needed on such conclusions as these; their fallacy is too apparent.

In all that had fallen from Mr. Mosely, it is said Dr. Lardner stated "his entire concurrence."

Spirit Levelling.—Dr. Lardner having observed that he had been obliged to have recourse to other methods for obtaining the inclinations of planes, on account of the inefficient method of our common modes of levelling, the Editor of this Magazine observed, that he was surprised at such an assertion; for that in giving instructions to two persons, who had been articled to him to be taught levelling, he had, with an inferior instrument, in which the aberration was great, levelled up and down the place in which he lives, falling 18 feet in 900, to within $\frac{3}{4}$ of an inch; and after the aberration had been corrected, he had gone round half a mile of very bad ground, within less than the tenth of an inch error. We understood Dr. Lardner's improved method of determining the inclination of the plane, was by taking the mean of the tractive forces up and down. On the Editor asking him what were the velocities, and whether allowance had been made for the resistance of the atmosphere, he said, "The experimental velocities were such, that the resistance of the air was insignificant." One of the velocities was 18, and the other 9 miles an hour. Now it is well known (see table, p. 95), that on 50 square feet surface, which is about that of the front of a Manchester train, the traction is increased by the air 15½lbs. at the latter velocity, and 62lbs. in

the former; or, at 8lbs. per ton, the load is augmented, in these cases respectively, by nearly 2 and 8 tons; no insignificant difference, we presume, in a case where our modern spirit levels are declared too inaccurate to find the inclination.

Throttling of Steam.—A discussion having arisen on the subject of the pressure of steam on the piston, the Editor of the "Railway Magazine" observed, that the steam, by our present pipes, was so excessively throttled, that frequently the pressure on the piston was not a third of the existing pressure in the boiler. He mentioned, in corroboration of his statement, an experiment, wherein the pressure of the boiler in one of the Manchester trains, at the foot of the Whiston plane, nearly a level, was 40lbs. per inch, while in ascending, where the pressure on the piston must have been four times as great, that of the boiler was only 50lbs. At the foot, the velocity of the train was upwards of 32 miles an hour, and in the ascent about 10. If, therefore, he observed, we suppose no throttling to take place in the slower motion, or that the pressures in the boiler and cylinder were the same, that is, 50lbs. to the inch, yet at the foot of the plane, where the velocity was 32 or 33 miles an hour, it could only be $\frac{1}{4}$ of it, or $12\frac{1}{2}$lbs. to the inch, $40 - 12\frac{1}{2} = 27\frac{1}{2}$lbs. being lost by throttling. Mr. Mosely hinted, that the superior work in the inclined plane must have been done by the expansive power of the steam; but such expansive power ought, obviously, to have given a less, not a greater pressure. During this discussion a gentleman came to the Editor, and stated to him his perfect concurrence in what the Editor had said, observing, that in his steam engines they estimated one-half the force lost "in driving the steam into the cylinder." The force lost will evidently depend on the velocity of the piston, and smallness of the steam pipe supplying the cylinder.

Many other valuable papers and subjects were discussed, some of which we may hereafter notice.

SUMS VOTED BY THE ASSOCIATION FOR SCIENTIFIC OBJECTS.

Mathematical and Physical Science.—250*l.* for the discussion of observations on the tides; 150*l.* for ditto on the tides of Bristol; 70*l.* for deduction of the constants of lunar mutations; 30*l.* for hourly observations on the barometer and hygrometer; 100*l.* for meteorological observations on a uniform plan, and on subterranean temperature; 500*l.* for data for determining the exact permanence or variation in the relative level of the land and sea; 100*l.* for experiments on the influence of wind and the forms of canals on the figure of waves; 500*l.* for reductions of the observations in the *Histoire Celeste* and Vol. ix. *Acad. des Sciences*, 1789 and 1790; 150*l.* for experiments on vitrification; 80*l.* for making a lens of rock salt.

Chemistry and Mineralogy,—50*l.* for experiments on the specific gravity of gases; 30*l.* for researches on the quantities of heat

developed in combustion and other chemical combinations; 15*l.* for experiments on the components of atmospheric air; 24*l.* 13*s.* for the publication of tables of chemical constants; 60*l.* for experiments on the strength of iron made with the hot and cold air blasts.

Geology and Geography.—20*l.* for experiments on the quantities of mud suspended in river waters; 30*l.* for special experiments on subterranean temperature and electricity; 50*l.* for ditto on the nature and origin of peat mosses in Ireland.

Zoology and Botany.—25*l.* for experiments on the growth of plants under glasses and excluded from air, according to Mr. Ward's plans.

Medicine.—50*l.* (renewed grant) to investigate the anatomical relations of veins and absorbents; 50*l.* (ditto ditto) the motions and sounds of the heart; 25*l.* to investigate the chemical constitution of the secreting organs; 25*l.* to investigate the physiological influence of cold on man in the Arctic regions; 25*l.* (renewed grant) to investigate the effects of poison on the animal economy; 25*l.* (renewed grant) to investigate the pathology of the brain and nervous system; 25*l.* to investigate the physiology of the spinal nerves.

Statistics.—150*l.* for inquiries into the state of schools in England, as to numerical analysis.

Mechanical Science.—50*l.* for an analysis of the duty of Cornish steam engines.

All these sums are under the control of particular individuals named and appointed.

REPORTS TO BE MADE FOR NEXT MEETING.

Captain Sabine, a continuation of his report on the magnetism of the earth; Mr. Lubbock, on the construction of new empirical lunar tables; Professor Johnstone, on the present state of our knowledge of the chemical and physical properties of dimorphous bodies in their forms; Mr. J. Taylor, on the mineral riches of Great Britain in relation to the metalliferous districts; Mr. Yarrell, on the state of our knowledge of Icthyology; the Rev. W. Taylor, of York, on the various methods of printing hitherto contrived for the use of the blind.

RECOMMENDATIONS, ETC.

That Captain Sabine's magnetical observations on the west coast of Scotland be printed in the next volume; that application be made to the French Government for copies of the best tide observations; that the Rev. Mr. Harcourt continue his experiments on long continued heat on mineral bodies; that the attention of members be called to the discovery of plants of any kind in slate rocks of any age older than the coal formation.

Facetiæ.—Many witty observations passed during the time the Association was in Bristol. One, which was particularly levelled

at the over-strained flattery of some of the professors to each other, we give:—"I am sorry to find," said a gentleman to his friend one day, "that butter has suddenly risen from 1*s.* to 1*s.* 6*d.* a pound, in consequence of the great quantity used by these professors on each other."

The Bristolians may be allowed to exercise a little wit, for this visit has cost them above 2,000*l.*

HIGH PRESSURE ENGINES, FROM WALLACE'S PRACTICAL MECHANICS' POCKET GUIDE.

High Pressure Engine.—Those engines in which the steam, after having performed its work, instead of being condensed, is allowed to escape into the atmosphere, are generally called high pressure, but more properly non-condensing engines. The steam which constitutes the moving power is generated under a great pressure, and its excess above that of the atmosphere, which is generally from 30 to 40 lbs. per circular inch, is the effective pressure. The working parts of a non-condensing engine are, the cylinder having steam passages furnished with cocks or valves to admit the steam either at top or bottom, and similar apparatus for its escape; with the air-tight piston, piston-rod, working-beam, crank, and shaft, as before. When the piston is at the bottom of the cylinder, and the steam passage open below, and the communication with the atmosphere open above, the rest being closed, the steam rushing from the boiler will press on the bottom of piston, and cause it to ascend. By the time it has reached the top, the steam communication below, and the atmospheric communication above are both shut, and the opposite communications above and below are opened: the steam then rushing from the boiler on the top of the piston will cause it to descend, while the steam that was below will escape into the atmosphere; in this manner the alternate motion is continued. The passages are closed a little before the end of the stroke, to prevent concussion against the ends of cylinder, or strain on the crank shaft; when properly managed, the elasticity of the steam destroys the momentum of the piston, and causes it to recoil without loss of force.

To calculate the Power of a High Pressure Engine.—The excess of the force of steam in the boiler above the pressure of the atmosphere, as shown by the steam gauge, is the motive force; but the loss of force due to frictions, waste, coolings, opening of valves, cutting off steam before the end of the stroke, &c., is estimated by Mr. Tredgold at ·4 of the force of the steam in the boiler, consequently the effective pressure is only ·6 of this force, diminished by the pressure of atmosphere. Hence, *when the engine is working at full pressure,* multiply the difference between

six-tenths of the excess of the force of the steam in boiler above the pressure of the atmosphere, and four-tenths of that pressure, in pounds per circular inch, by the square of the diameter of the cylinder in inches, and by the velocity of the piston in feet per minute, and the product is the number of lbs. raised one foot higher per minute, from which the number of horses' power may be found as before. If the area of the piston in feet be multiplied by the velocity per minute in feet, the product will be the volume of steam, when of the same density, as that in the boiler; if this product be divided by the volume of steam which a cubic foot of water forms at the temperature or force in the boiler, the quotient is the cubic feet of water consumed per minute.

When the Engine is working Expansively.—1st. *To find the mean effective pressure on the piston,* add 1· to 2·3 times logarithm of the reciprocal of the fraction, denoting the part of the stroke at which the steam is cut off; divide the sum by that reciprocal, and subtract ·4 from the quotient; multiply the remainder by the whole force of the steam in the boiler per circular inch, and from the product subtract 11·55 for the pressure of the atmosphere; the remainder is the mean effective pressure in lbs. per circular inch. 2d. *To find the power,* multiply the mean effective pressure by the square of the diameter of the piston in inches, and by the velocity in feet per minute, and from the product find the number of horses' power as before. If the area of the piston be multiplied by the velocity in feet per minute, and the product increased by one-tenth part, divided by the reciprocal of the fraction above mentioned, the quotient is the quantity of steam in cubic feet consumed per minute; from this quantity, the number of cubic feet of water required may be found, as before.

Length of Stroke and Velocity of an Engine.—The stroke of an engine is equal to one revolution of the crank shaft, and consequently to double the length of cylinder. In common parlance, however, the length of stroke and the length of the cylinder are synonymous; in this sense it is to be understood, in the following rules by Tredgold, for finding the proper velocity of the piston:— 1st. If the engine be regulated by a fly, and the pressure on the piston be the same throughout the stroke, the best velocity is 120 times the square root of the length of the stroke in feet. 2d. If the steam act expansively, the velocity is found by multiplying the logarithm of the reciprocal of the fraction, denoting the part of the stroke where the steam is cut off, by 2·3 adding ·7 to the product, and multiplying the sum by that fraction; then taking 120 times the square root of the product. 3d. If the steam does not act expansively, the velocity is equal to 103 times the square root of the length of stroke. 4th. If the steam act expansively, at the ordinary pressure of about 8 lbs. per circular inch of the safety-valve, and the steam is cut off at half the stroke the velocity is 100 times the square root of the length of the stroke. In the following table,

exemplifying the application of the preceding rules, the diameter of the cylinder is supposed to be 30 inches, the depth 60 inches, or 5 feet, and the velocity 22 double strokes per minute, or 220 feet per minute, the usual rate of the piston in steam-engines.

Comparative Table of the Power of the different kinds of Steam Engines.

Kind of Engine.	Stroke.	Velocity.	Diameter.	Temperature.	Pressure of Steam.	Horse Power.
		ft.	in.		in.	
Common Atmospheric . . .	full	220	30	212°	30	18
Do., with Condenser	full	220	30	212°	30	19
Single acting Low Pressure . .	full	220	30	220°	35	20
Do., Expansive	¾	220	30	220°	35	18
Double acting Low Pressure . .	full	220	30	220°	35	43
Do., Expansive	½	220	30	220°	35	28
High Pressure	full	220	30	277°	45	58
Do., Expansive	¾	220	30	277°	45	51

PROGRESS OF RAILWAY WORKS.

GREENWICH RAILWAY.

There is only, we are informed, an iron girder wanted for the arch over Bermondsey Street, to enable this line immediately to be completed from London Bridge to Deptford. Beyond Deptford the arches are up, and no obstacle appears to us why the whole line should not be opened this month (October). We have particularly inquired into the reason that it was not completed last August, according to the declaration in the Lords of Mr. Walter, whom, we confess, we had been much inclined to blame, and in no very measured terms, for having wilfully misled the public. However, we are satisfied, from the information received, that Mr. Walter is not to blame; the delay has arisen from what he had no right to anticipate, and, though we cannot agree with his reasons for not publishing the cause—which we think is due to the public—we are bound to admire the man.

We have been amused at the inventions to decry this line for particular purposes. A report the other day was circulated, that the Company could not go on for want of money—that they were 100,000*l.* in debt to Mr. M'Intosh the contractor. The party who brought a report of this rumour to the office, where Mr. M. happened to be, was at once told by that gentleman that the Company owed him not a shilling. Another rumour, last Thursday, September 22, was, "That a great embezzlement had been dis-

covered in the concern." The answer we received to this, from a highly respectable man and an influential member of the Board, was simple and decisive—"There is nothing to embezzle."

The whole origin of these pretty inventions, it seems, lies among certain gamblers who have sold for time, and want to run the shares down, that they may buy in for the transfer. We hope, however, the holders will not be so gulled.—Ed.

MANCHESTER AND LIVERPOOL INFLUENCE IN RAILWAYS.

The enterprising inhabitants of these towns will, in all probability, ere long control two-thirds of the railroads in the kingdom. The Southampton, Midland Counties', and Eastern Counties' have already submitted to their dictation. We do not say this is unreasonable. Men, who risk their money, ought to have a controlling voice; and it is quite certain that, had it not been for Liverpool and Manchester capital, most of the railroads must have stood still. In the Southampton line, full one half the capital was found in Manchester; in the Eastern Counties', from a third to a half; and in the Midland Counties', we hardly know how much; besides other lines almost without number.

GREAT WESTERN RAILWAY.

At the second half-yearly general meeting of the Great Western Railway Company, held at the Guildhall, Bristol, August 25th, 1836, Benjamin Shaw, Esq., in the chair, it was resolved—that the report now read be received and adopted;—that the Directors be authorized to apply to Parliament in the ensuing session for powers to carry into effect the provisional arrangements already effected, for continuing the line of railway from Acton to the proposed terminus at Paddington, and, in the mean time, to take all such measures, as may appear to them expedient, to secure the opening of the work at the earliest possible period.

Report.—Since the last report the whole line between Bristol and Bath has been set out, and the works commenced at all the principal points. The contracts made, insure its completion by February, 1838.

Between Bath and Chippenham active measures have been taken for proceeding with the principal work, viz., the Box Tunnel, where temporary shafts have been already sunk, and arrangements made for letting the contracts for its completion, some of which are advertized. From the result of the opening of the trial shafts, for ascertaining the nature of the soil, it appears certain that there can be no difficulty in completing the tunnel in three years.

The contracts from Acton to Reading, a distance of 32 miles, are also taken, and for the most part in active operation.

The works to Maidenhead will be completed within twelve months from the present time, and it remains only for the proprietors to determine at this juncture, whether the same spirit and energy shall govern the proceedings of the Company, in pressing forward, during that short period, the construction of a connecting

line between Acton and London, so as to render their labours useful to the public and beneficial to themselves, with the least possible delay.

The Directors have already made known the circumstances which terminated every hope of a junction between the London and Birmingham Railway, on the terms of reciprocal benefit or of permanency, at a season of peculiar inconvenience, in relation to Parliamentary proceedings, for another line. The Directors having applied themselves, however, to counteract that unexpected difficulty, by seeking the most eligible position for a separate depôt in London, have now the pleasure to announce, that they have obtained the general consent of the owners and occupiers to an extension line into Paddington.

The length of it from Acton will be about 4½ miles; but, allowing for the line which was intended to have been made to Kensall Green, the Company will only have to construct 2½ miles of additional railway, in order to secure a separate approach to the metropolis, instead of using 5 miles of the London and Birmingham Railway in common with that Company. It thus avoids the two tunnels between Harlesdon and Euston Grove; and the gradients will not exceed 4 feet per mile. Ample space for the station at Paddington has been secured. Conditional arrangements have been made with the landed proprietors, leaving only a few unimportant points of detail to be finally adjusted, upon receiving the sanction of the Company for an application to Parliament to carry the measure into effect.

It is naturally an object of much importance, that the opening of the railway to Maidenhead should not be delayed by the works in the neighbourhood of London; and the Directors have found a ready concurrence on the part of the landowners, in permitting immediate operations upon their respective properties, so as to complete the whole line from Paddington to Maidenhead, in the Autumn of next year. The sanction of Parliament to the proposed line being a measure of such obvious necessity, recommended also by the unanimous approbation of every owner, and, indeed, of every parish affected by it, may well be anticipated with confidence, on public grounds.

If the proprietors shall think fit to direct the course of proceeding thus recommended by the Directors, the public will derive the advantage of using 22 miles of railway at the earliest period, and the Company will receive a corresponding benefit in a quick and ample return for the sum invested, without having incurred any delay from this unavoidable alteration of the line.

In finally setting out the general works for execution, the engineer has been enabled to introduce many material improvements in the curves and general character of the line, and particularly to effect a still further reduction in the gradients or inclinations.

Between Bristol and Bath the railway will now consist of one constant and regular inclination, of only 4 feet per mile, or 1 in 1320. Between London and Reading, and thence to the Oxford branch, there will be no gradient exceeding 4 feet per mile, and a great part will be even at a less inclination. The remainder of the line is now in progress of being defined and set out, and there is every reason to anticipate similar improvements upon it.

It is expected that by these ultimate arrangements, the locomotive engines on the Great Western Railway, will nowhere have to surmount a greater inclination than 5 feet 6 inches per mile,* and probably even less, the only two inclined planes of 1 in 107, near Wootton Bassett and at Box, being worked by stationary power.

These very favourable gradients, unequalled upon any railway of great extent now in progress, will insure such an economy in the cost of locomotive power, as materially to reduce the estimated annual expences, and a proportionate increase of profits will be received by the proprietors. They will moreover greatly facilitate the attainment of a higher speed of travelling.

Under these peculiar circumstances, and with the view of obtaining the full advantage of the regularity and of the reduction of power effected by this near approach to a level, and also to remedy several serious inconveniences experienced in existing railways, an increased width of rails† has been recommended by your engineer, and, after mature consideration, has been determined upon by the Directors.

Difficulties and objections were at first supposed by some persons to exist in the construction of engines for this increased width of rails, but the Directors have pleasure in stating, that several of the most experienced and eminent manufacturers of locomotive engines in the north, have undertaken to construct them, and that several engines are now actually contracted for, adapted to the peculiar dimensions and levels of this railway, calculated for a minimum velocity of 30 miles per hour.

These engines will be capable of attaining a rate of 35 to 40

* If so, the engines will be able to use full steam up and down, and the time of transit will be very nearly the same as on a perfect level.—Ed.

† If more surface is to be exposed by encreasing the front area of the carriage, it will prove a great disadvantage. But if, as we understand, the wheels are to be made larger, and the bodies lowered between them, it will doubtless induce greater safety, prove very convenient for the transport of goods, and, in our opinion, reduce the vibrating motion, and, consequently, the wear and tear of the road and trains. Experiment has proved that larger wheels in the engine work with more economy. This has ever been our opinion on scientific views; we may, perhaps, hereafter give our views. We want to know how there is to be any intercommunication between different railways, if one is to have one breadth between their rails and another a different. We do not find fault with an increased breadth, but ought not all to be compelled to have the same?—Ed.

miles per hour, with the same facility as the speed of 25 to 30 miles is gained by those now constructed for other lines.

The Bills for railways from Bristol to Exeter, from Swindon, through Stroud, to Gloucester and Cheltenham, and from Merthyr to Cardiff, have received the Royal assent, and the Directors have the assurance, that all these measures will be carried into effect with the utmost vigour and dispatch. It is almost superfluous to remark, that the Great Western Railway Company are materially interested in the successful completion of those undertakings.

A branch to Oxford, and a continuation of it to Worcester, are also promoted by the leading interests of those cities, and the best exertions of the Company will be devoted in co-operation with them to accomplish those objects.

A statement of the finances of the Company, to the 30th June, is now submitted to the Proprietors.

(Signed) BENJAMIN SHAW,
Chairman.

Statement.

To amount received on account of capital to 30th June		£495,345 0 0
Ditto on account of Interest on Investments, &c.	£509 6 5	
Ditto Registration Fees, &c. . . .	287 12 6	
		796 18 11
		£496,141 18 11

General Abstract.

By amount of expenses incurred to 24th Oct. 1835, as detailed in former statement .		88,710 10 11	
By payments to 31st December, 1835, as per last Half-Yearly Report . . .		4,322 1 5	

By Payments between 1st January and 30th June, 1836, viz.

For land and compensation	£61,922 10 10		
Contracts for works .	15,354 12 4		
Engineering, surveyors, &c. &c.	10,769 17 8		
Advertisements, printing, &c.	295 11 7		
Travelling expenses . . .	242 2 5		
Costs of title to land .	44 11 0		
General disbursements, consisting of office expenses, direction, salaries to secretaries and clerks, postages, &c. .	3,883 3 8		
		92,512 9 6	
			185,545 1 10
			£310,596 17 1

(Signed) BENJAMIN SHAW,
Chairman.

REPORT OF THE COST, EXPENDITURE, AND INCOME OF THE RAILWAY BETWEEN BRUSSELS AND ANTWERP.

The railway between Brussels and Antwerp is now completed; and, as it is one of the latest of the Continental enterprises, the following statement of its present position, reduced to English money and measure, will not be uninteresting.

LINE OF RAILWAY.	COST OF SECTIONS. From Mechlin to Brussels, Distance 12 Miles, 6¼ Furlongs.	From Mechlin to Antwerp, Distance 14 Miles.	ORIGINAL ESTIMATE.
Purchase of land for double line	£9,437 8 4	13,219 17 6	22,636 16 8
Lands purchased to be resold	4,263 8 4	6,964 2 6	Unknown.
Earthworks for double line	5,279 14 2	11,405 15 10	7,040 0 0
Masonry, bridges, &c.	2,793 5 10	7,360 0 0	12,230 0 0
Railway in single line, but with a double portion of 8 miles at the stations	33,806 12 10	31,978 16 8	67,856 0 0
Various machinery during the progress of the work	2,789 8 4	2,900 0 0	5,512 0 0
Direction, including cost of surveys	808 3 4	1,300 0 0	1,960 0 0
Contingencies	613 15 10	.. .. ..	.. .. ..
	£59,791 17 0	75,128 12 6 59,791 17 0	
Joint total	.. .. ..	£134,920 9 6*	117,236 16 8

Original Cost of Land and Buildings, and of Locomotive Engines and Carriages.

ORIGINAL COST.	SECTIONS. From Mechlin to Brussels.	From Mechlin to Antwerp.
Land and buildings	£7,326 12 6	15,296 12 6
Engines and carriages	6,304 0 0	12,394 0 10
Expense of direction and management	600 0 0	2,919 0 10
	£14,230 12 6	29,819 14 2 14,230 12 6
Joint total	.. .. ..	£44,050 6 8

* The increase upon the original estimate is occasioned principally by the calculations having been made for rails of 35 lb. the yard, whereas seven-eighths of those used are of 45 lb.; and because it was necessary to purchase land not requisite for the railway, in order to meet the demands of the landowners, for a sum amounting to 11,227*l.* 10*s.* 10*d.*, which can certainly be resold at a profit.

Expense of Maintenance of Way, Locomotive Engines, Carriages and Management.

EXPENSES.	SECTIONS. From Mechlin to Brussels. Actual Expense for the first Year, from the 1st of May 1835, to the 1st of May 1836.	SECTIONS. From Brussels to Antwerp. Presumed Expense for the present Year, from the 1st of May 1836, to the 1st of May 1837.
Moveable workshops for the repair of the line, including rails, wood, and sand	£1,187 6 8	£2,000 0 0
Police, watchmen, and sweepers..	480 0 0	800 0 0
Wages of workmen	1,225 0 0	2,400 0 0
Wages of engineers	680 0 0	1,200 0 0
Direction and management	520 0 0	600 0 0
Office expenses and salaries	1,224 5 0	1,400 0 0
Contingencies	.. .. ..	80 0 0
	£7,356 11 8	12,000 0 0

Table of Revenue.

First Year—Revenue from the experimental Section between Mechlin and Brussels.

		Passengers.
1835—from 7 to 31 May	......	33,287
Month of June	......	52,543
	July	77,702
	August ...	72,381
	September.	72,522
	October ...	50,829
	November .	33,187
	December .	28,988
1836...................	January ...	28,709
	February...	30,859
	March......	34,707
	April	47,496
	Total...	563,210 Income... £14,376 0 0

Note.—During the month of May, 1836, the revenue has been—
From the 1st to the 20th May . 59,198 Passengers
... 21st to the 31st 42,281

Total for the first month, from the opening of the whole line from Antwerp to Brussels...101,479 Passengers £4,313 19 5

Actual Balance from the First Year.

Section from Mechlin to Brussels.

Expense of forming the road				£59,791	17	0
Original cost of land and buildings, locomotive engines and carriages				14,230	12	6
Total capital......				£74,022	9	6
Of which the interest at 5 per cent	£3,701	2	6			
Add the expense of maintenance, &c., from the 1st of May, 1835, to the 1st of May, 1836	7,356	11	8			
Total annual expense				11,057	14	2
The revenue from the section, during the same interval, was				14,376	0	0
Profit on the first year......				£3,318	5	10

Yielding, in addition to the interest of 5 per cent., about 4½ per cent. on the capital employed.

Estimate of the Expenses and Income on the whole line from Antwerp to Brussels, from the Carriage of Passengers alone, for the Year ending May, 1837.

Original cost, per statement				£134,920	9	6
Cost of land and buildings				44,050	6	8
Total......				£178,970	16	2
Of which the interest at 5 per cent	£8,948	10	10			
Add the expense of maintenance of way, &c.	12,000	0	0			
Total......				20,948	10	10
Deducting this from the estimated receipts, according to the experience of the month of May, which will amount to at least 1,100,000 Passengers, at				40,948	10	10
Presumed profit......				£20,000	0	0

Answering to about 11 per cent. on the capital invested, in addition to the ordinary interest of 5 per cent.

Fares from Antwerp to Brussels by the Railway.

	s.	d.	
Coaches	3	0	Six regular departures every day, from Brussels to Antwerp, and *vice versa*, passing each other at Mechlin.
Diligences	2	6	
Carts with benches...	1	8	
Waggons	1	0	

The average duration of the passage from Brussels to Mechlin (a distance of nearly 13 miles), is from 30 to 35 minutes, including stoppages.

That from Brussels to Antwerp (nearly 27 miles), is from 1h. 25m. to 1h. 45m., including stoppages, while the speed originally calculated was two hours.

Before the opening of the railway, from 15 to 20 diligences ran between Brussels and Antwerp, carrying a yearly average of 80,000 passengers, at from 2*s.* 6*d.* to 4*s.* each. These have entirely ceased to run, as well as the canal boats, except a few for the conveyance of goods, for which the railway has not yet been employed.

RAILWAY NOTICES.

Brighton Railway.—Notwithstanding the enormous expense already incurred by the rival parties in this proposed undertaking during the present session, the contest, it seems, is to be renewed with double vigour in the next, for which purpose each is already making active preparations. In one line, even the lawyers are so warmly embarked in the cause of their clients, as to have proffered their future services *for nothing.*

Bristol and Exeter Railway.—The Directors of this undertaking are impelling its progress. We learn that the line will carry the work within the boundary of that remarkable level, which continues, without interruption, to the immediate vicinity of Taunton, and that its gradients will not exceed eleven feet in a mile. This, we are informed, is to be immediately succeeded by a similar movement from Exeter towards the Valley of the Culm, and sanguine expectations are entertained that the whole will be opened at very nearly the same period of time, as that which is now anticipated for the completion of the Great Western Railway.

Cheshire Junction.—A meeting was held at Wilmslow, on Monday, at which various resolutions were agreed to approving of this Railway.

Calcutta and Saugur Railway.—[We have reason to believe the following article relates to the Calcutta and Saugur Railway, and will therefore prove highly gratifying to the shareholders of this undertaking.—Ed.] "We are glad to learn, that there is every probability of railways being soon laid down, both to the Mount and to the Red Hills; the *Conservative* says, an order to that effect has already passed Council.

Another report says, that it has received the approval of the Military Board, and waits the confirmation of Sir Frederick Adam; but we believe there is no doubt of the fact, that the estimates of both lines of road have been given in, and approved of by the authorities, and that they will be immediately carried into execution. If the calculation which we have heard has even any approximation to truth, there cannot be the slightest doubt of the desirableness of the establishment of these railroads, for it is stated, that one of them would pay the cost of construction in one year.—'Gazette,' April 16th."—(From the "Bengal Hurkaru and Chronicle, Saturday, April 30th, 1836.")

Cheltenham and Great Western Union Railway.—We understand that the engineer, Mr. Brunel, has received instructions from the Directors to set out the line, and proceed in the execution of it with all possible dispatch; and that the Directors have a balance in hand on the deposit of 2*l.* 10s. per share, paid up, after liquidating every demand upon them up to the passing of the Act.

Railway to the Cove of Cork.—At a meeting held in Cork, of the gentlemen interested in the projected railway to Cork, it was resolved, that subscriptions should be immediately set on foot for the purpose of surveying the ground between Cork and Cove. Opinion at present appears to favour a commencement near the present Packet-office; then a water level by Glanmire; then by the rear of the Little Island and the eastern shore; then across to Merino; and so, by the river's edge, to Cove.

Devizes and Melksham Branch Railway.—The Directors of the Great Western Railway have offered to take a considerable number of shares in the Devizes and Melksham branch, provided a given number of shares were first subscribed for by persons of the neighbourhood. There is also a probability that there would be a deviation from the original line of the Bradford and Trowbridge Branch of the Great Western Railway, so as to bring it much nearer to Melksham, which would afford a saving to the shareholders of about 10,000*l.*

Railroad between London and Dublin.—Great efforts are making to secure the shortest and best line of communication between the two capitals of England and Ireland. A considerable difference of opinion exists as to the Shrewsbury line and the Holyhead harbour, and as to which is the best route and best harbour. At present nothing seems to be fixed on.

Durham and Sunderland Railways.—Since the opening of these railways, a novel experiment has been tried upon the line, which proves the practicability of railroad vehicles being propelled by wind. A temporary mast and sail were erected on a vehicle, which was set agoing at an easy rate. On the sail being trimmed to the wind, the speed increased to the rate of ten miles an hour. A train of five coal waggons was afterwards attached, but no additional sail hoisted.

Grand Junction Railway.—The whole of this line is in so for-

ward a state, that it is expected it will be open for travelling early in the summer of 1837. Fourteen of the twenty arches of the splendid viaduct across the Weaver are finished; it, as well as the viaduct near Birmingham, will be completed next spring. There are several parts of the line ready for the iron rails being laid down, all the carriages are in a forward state, and twenty-five locomotive engines will be ready for action in March. The contracts for the rails and chains were made at a fortunate period, being 15 per cent. less than they could now be obtained for. The income derivable from the Warrington and Newcastle Railway, now forming part of the general line, yields a surplus, after paying the recent proprietors the sum of 4 per cent. per annum, as agreed upon to be paid to them until the opening of the whole line. The proprietors were unanimous in their desire to support the line between Manchester and Crewe, and to assist the inhabitants of the Potteries to form a branch line to the Grand Junction Railway, near Newcastle. Messrs. John Moss, James Heyworth, and Joseph Sanders, the Directors who were to go out of office by rotation, have been re-elected.

The Greenwich Railway Company have commenced lighting their line with gas. Its appearance from the Old Kent Road is very brilliant, and when completed to London Bridge, it will certainly be one of the most splendid displays of gas in Europe.

Halifax and Leeds Railway.—A project is on foot for a railway from Halifax to Leeds by way of Bradford. The Halifax terminus is proposed to be at West House, in King's Cross Lane; and the line will proceed in the direction of Ovenden, passing through Swill-hill, by a tunnel, into Bradford Dale.

Hull and Selby Railway.—Mr. Walker, the engineer, has had an interview with several of the Directors of the Hull and Selby Railway. The line of railroad is to be staked out forthwith, and immediate measures taken to enable the Directors to contract for the works, which they appear determined to prosecute vigorously, and without delay. Shares are now taken for the whole estimated cost of this undertaking, 384,639*l.*, as required by the Act of Parliament, so that the Directors will be able immediately to prosecute the work. The capital in the Act is 400,000*l.*, so that about 300 shares are now reserved (viz. 15,000*l.*), which, there is no doubt, that landowners and others on the line will speedily take. The Directors have a balance of upwards of 26,000*l.* in hand, and it is likely that no call will be made on the shareholders in the present year.

Liverpool and Manchester Railway.—The new tunnel has now been in operation for a fortnight, and everything about it appears to work well, and to give satisfaction. The communication of signals can be made from one end to the other in twenty-five seconds, by means of a very ingenious apparatus, by which a powerful current of air is driven through the tube with sufficient

force to ring a bell or blow an organ pipe, which latter has been preferred. Great and rapid progress is making in relaying the railway with new rails.—*Liverpool Mercury*, Sept. 9.

Manchester and Cheshire Junction Railway.—At a meeting, numerously attended, of the shareholders, Benjamin Braidley, Esq., in the Chair, Mr. Wheeler, the Solicitor to the Company, made a report of the proceedings of the Committee, since the last meeting, on the 28th of May, in the course of which he adverted, with a view to their refutation, to a considerable number of statements put forth by the South Union Company, regarding the Cheshire Junction project. He was warmly applauded at the close of his exposition. Mr. Brooks vindicated Mr. Egerton's adherence to the interests of the Stockport people. He had met Mr. Lingard, one of the solicitors, who expressed a strong desire to have the matter settled, and said, he thought the terms offered very reasonable.

Manchester and Leeds Railway.—The first general meeting of the proprietors of this railway was held at Manchester, on Thursday last, James Wood, Esq., in the Chair. The Report of the Provisional Directors was laid before the meeting, from which it appeared that, according to the evidence laid before the Committee of the House of Commons, the population, within three miles of this line, was 1,849 persons to the square mile; that the estimated probable annual number of passengers from various distances along the line was 207,688, being equivalent to 116,399 the whole length, &c.; and that the probable income from passengers would be 115,256*l.* odd, and from goods 113,707*l.*; making together, 228,963*l.* 6s. 8d., at the rate of 2d. per head per mile, for passengers; 2d. per ton for minerals; and 4d. per ton per mile for goods. The proposed capital is 1,300,000*l.*

Newcastle-upon-Tyne, Edinburgh, and Glasgow Railway.—At a meeting held at Peebles the engineer, Mr. Richardson, described the proposed line, starting from Newcastle-upon-Tyne, in the direction of the Reed Water, then to the Carter, and onwards to Jedburgh, with branches to Kelso and Hawick, Selkirk, &c., continuing onwards to Peebles, and up the Tweed onwards to Lanark, and by Hamilton, to Glasgow. It had been originally intended to branch off to Edinburgh by Galashiels, but he had examined the line from Peebles to Edinburgh, *via* Pennycuick; and he had found that line to present fewer difficulties on the whole than the other, and had the advantage of a considerable saving in distance. A western line had been proposed, considerably longer than the line projected by Mr. Reed. This western line was proposed to strike off from London by Coventry, onwards to Warrington, then to Preston, and so on. It was proposed to go nearly by the coast, to cross the Solway Frith to Annan and Dumfries, and onwards, nearly by the present road to Kilmarnock, and then to Glasgow. The populations were, of the Midland

Line, 509,177; of the Eastern Line, 294,533; difference, 214,644. On a careful examination of the map, he found the distance from London to Edinburgh, by the Midland Line, to be 381 miles, from London to Glasgow 404 miles. By the Western Line, the distance from London to Edinburgh was 400 miles; and from London to Glasgow 411 miles. By the Eastern Line, from London to Edinburgh, the distance was 397 miles; and from London to Glasgow 429 miles; making, as they would see, a difference as to the length of the Eastern Line, and that now under their consideration of sixteen miles to Edinburgh, and twenty-five miles to Glasgow, and a difference between the Western Line and theirs of nineteen miles to Edinburgh, and seven to Glasgow. This line was originally projected by Mr. Stephen Reed, of Newcastle.

Newcastle and Carlisle Railway.—The receipts of the part of the line already open of the Newcastle and Carlisle railway, infinitely exceed the anticipations of the Directors and proprietors. It was at first imagined that an annual income of 30,000*l.* might be received from the whole line, but we now find, that even along the part opened, it bids fair to realize 50,000*l.*, and one of the gentlemen of Newcastle, who has taken a very active part in the financial department, has expressed his strong conviction that, when opened through, the annual receipts would be at least 90,000*l.*, being treble the sum originally set forth.

North Midland Railway.—Several gentlemen connected with the North Midland Railway, have been re-surveying the line from Bullbridge to Chesterfield. They are now employed on the line from the latter place to Rotherham. Workmen are expected shortly to begin operations near Clay Cross, where the first portion of the road will commence being formed.

Advantages of the Railway.—The other day a farmer beyond the South Esk, brought eleven tons of wheat at once with a single horse, from Newton Grange, to the granaries in St. Leonard's Depôt, and the saving he computes as follows:—He got waggons from the Railway Company, and used his own horse.

He paid the railway dues		13s. 9d.
His horse and man, a day		4s. 0d.
Half a day of two horses and carts loading waggons		4s. 0d.
Total cost by the Railway		21s. 9d.
By carting the same to Edinburgh, he would have employed eleven horses and carts a day	44s. 0d.	
Two tolls on ditto	7s. 4d.	
Total by the high road		51s. 4d.
Saving by using the Railway		29s. 7d.

Yet, strange to say, in this well-informed age, very little traffic, we are told, has taken place hitherto in the above way.

Railway from Shrewsbury to Wolverhampton.—On Saturday, August 27, a meeting of the inhabitants of Shrewsbury was held, the Mayor in the Chair, for the purpose of considering the best line of railway between the above-named places, in connexion with the railway from Birmingham to London. It was numerously attended, and a series of resolutions were carried unanimously. Mr. Bidder, who attended on behalf of Mr. Stephenson, the engineer, stated, that the proposed line was the best that could be pointed out, with regard to local interests, and the general view of the country. The length of tunnel required would be about a mile, whilst, on another line which had been proposed, the tunnel would require to be two miles and a half in length, and there would also be less excavation on the line proposed by Mr. Stephenson. When the meeting was about to separate, Mr. R. A. Slaney entered, and expressed his anxious wish to concur in every thing that would benefit the town of Shrewsbury. A branch of the proposed railway would pass through his property at Dawley, and he should be most happy to make any sacrifice in order to ensure its being completed.

Sheffield and Midland.—This projected railway owes its origin to the North Midland, leaving Sheffield at five miles distance—the town having opposed the North Midland on that ground—as well as that a line, to pass through, or near to Sheffield, would be practicable, if time was allowed for farther surveys. Though the North Midland Bill was passed last session, the Committee of the Lords came to a resolution, in some degree sanctioning the above scheme, by which Sheffield would have a railway direct to London and Birmingham; while, to the passengers, nine or ten miles would be saved in the distance to London, by passing over a part of the line to the Midland Counties' Railway, in preference to going round by Derby, as intended by the Act of the North Midland. Mr. Locke has been joined to Mr. Leather in taking minute surveys, preparatory to an Act being applied for in the ensuing session.

Sheffield and Goole, and Sheffield and Humber Railways.—These are two rival schemes of communication with the Eastern Ocean; both branch from the North Midland, near to Rotherham, the one terminating at Goole, the other passing over the Ouse near that place, and joining the Hull and Selby Railway on the other side of the river.

Sheffield and Manchester.—There are few railways in projection more strongly and respectably supported than this line, and the fact of there being no water carriage between the two places, makes such a means of communication quite necessary. The surveys are progressing rapidly under Messrs. Vignolles and Locke.

York and North Midland Railway.—A meeting of the influential inhabitants of Brixham and its neighbourhood, took place on Wednesday last, to take into consideration, and to adopt, such measures as may best conduce to the accomplishment of a junction line, connecting Torbay and the south coast of Devon, with the proposed main line of railway between Plymouth and Exeter. Mr. Stephenson will immediately commence laying out the intended line of rails for this undertaking. Mr. Walker, engineer of the North-Eastern Railroad, from London to York, *via* Cambridge, is to confer with the Directors of the York and North Midland Railway, as to the most eligible point at which a junction of the two railways shall be formed. The Directors are in correspondence with the Directors of the Great North of England line, from Newcastle; and it is said that this line will be brought up to this city, and not carried past it by a curve, as was at first projected.

FOREIGN RAILROADS.

Railroads in Belgium.—The accounts from Belgium give the following details relative to the success of the railroad between Brussels and Antwerp, from which the Government is likely to realize great profits:—The road is 24 English miles long. It has been opened four months, and has carried 430,000 passengers, and the average fare being a fraction more than a franc each, the year's return would be 1,300,000f. (upwards of 50,000*l.*); but, allowing for a diminution of traffic in winter, 1,000,000f. are only taken credit for, and the road (a single line of rail) having cost 4,500,000f., the profits of the Government are manifestly immense. The parties who, in 1832, pressed the Belgian Government for a grant to enable them to make this very road, estimated the traffic at 92,000 passengers in the year, which is less by 25,000 than have been carried upon it in the past month only.

Railroads in the Island of Cuba.—A railroad of considerable extent, running through the most fertile parts of the Island of Cuba, and connecting two of the largest towns, is now nearly laid down, and it is expected before many months, to come into full operation. Several hundred workmen are employed daily upon it. The present Governor, Don Miguel Tacon, has placed at the service of the managers of the road a considerable number of convicts, so that the works go on uninfluenced by the demand for labour in other districts in this most flourishing colony.

Railroad in Russia.—A locomotive engine, of the most superior workmanship, which has just been constructed for the Petersburgh and Pawlowsky Railway at the manufactory of Messrs. R. Stephenson and Co., has had a trial, and exceeded the extraordinary speed of sixty-five and a half miles per hour!

Railroad from Quebec to St. Andrew's.—The railway which it

is proposed to form between St. Andrew's and Quebec will be 250 miles long. It is estimated to cost a million sterling. The Government has contributed 10,000*l.* from the land revenue towards the undertaking.

Railroads in Russia.—The railroad from St. Petersburgh to Zarskojeselo and Pawiosk has just been completed, and will be opened in October next; and in the spring two others are to be commenced, from the capital to the Imperial residences of Peterhoff and Oranienbaum.

Railroads in America.—The last New York papers announce the opening of the longest continuous line of railway in the United States on the 25th ultimo, the Utica and Schenectady railways, an event of considerable interest to the people of the United States, no similar undertaking of equal magnitude having been previously completed in that part of the world, nor, indeed, in any other. The time occupied in its construction is stated to have been 21 months, the length of the line being 77 miles, and its cost, including 8 locomotive engines and 100 cars, 1,500,000 dollars (about 310,000*l.* sterling). The first excursion, from Utica to Schenectady, was performed in 4 hours and 20 minutes, the time consumed in running, allowing 53 minutes for stoppages, being 3 hours and 20 minutes; while the return journey was accomplished in 4 hours and 9 minutes, the time occupied on the road, deducting 36 minutes for stoppages, being 3 hours and 33 minutes.

PARLIAMENTARY PROCEEDINGS ON RAILWAYS.

PROPOSED AMENDED STANDING ORDERS WITH REGARD TO RAILWAY BILLS FOR SUBSEQUENT SESSIONS.

[Continued from p. 293.]

6. That parties desiring to make any alteration in the line of any railway, the plans for which shall have been deposited and the notices for which shall have been given as before-mentioned, shall be permitted so to do, provided no one deviation shall exceed one mile in length, and provided a plan and section of such alteration, together with a book of reference thereto, with the clerk of the peace, and a plan and section, so far as relates to each parish, together with a book of reference thereto, with the parish clerks of the several parishes in which such alteration is intended to be made, on or before the 30th day of November, in the year immediately preceding that in which such application is intended to be made; and that the intention to make such alteration shall be advertised in manner before directed, twice in the month of September, twice in the month of October, and twice in the month of November; and that personal application shall be made to the owners or reputed owners, lessees or reputed lessees, or in their absence from the United Kingdom, to their agents respectively, and to the occupiers of lands

through which any such alteration is proposed to be made; which application in writing shall point out the particular land or building belonging to such owners or reputed owners, lessees or reputed lesses, which are purposed to be taken for the purpose of such railway, and shall also state, whether such railway is intended to pass through such land or building upon the level or upon an embankment or cutting, with a reference to the number on the plan deposited with the clerk of the parish, wherein such land or building is situated.

7. That parties desiring to make an application for a Bill to vary, extend, or enlarge any line of railway, for making which an Act of Parliament shall have been passed, shall be permitted so to do, provided that no one deviation shall exceed one mile in length, and provided a plan and section of such variation, extension, or enlargement, together with a book of reference thereto, shall be deposited with the clerk of the peace, and a plan and section, so far as relates to each parish, together with a book of reference thereto, with the parish clerks of the several parishes in which such variation, extension, or enlargement is intended to be made, on or before the 30th day of November, in the year immediately preceding that in which such application is intended to be made; and that the intention to make the application for such variation, extension, or enlargement, shall be advertised, in manner next before directed, in September, October, and November; and that personal application shall be made to the owners or reputed owners, lessees or reputed lessees, or in their absence from the United Kingdom, to their agents respectively, and to the occupiers of the lands through which any such variation, extension, or enlargement is proposed to be made; which application in writing shall point out the particular land or building belonging to such owners or reputed owners, lessees or reputed lessees, which are purposed to be taken for the purpose of such railway, and shall also state, whether such railway is intended to pass through such land or building upon the level or upon an embankment or cutting, with a reference to the number on the plan deposited with the clerk of the parish, wherein such land or building is situated.

[To be continued.]

RAILWAY BILLS PASSED LAST SESSION.

In our last Number's list we omitted the Thames Haven Railway Company, which also obtained their Bill.

ERRATA IN NO. VII.

Page.
240, in 7th line of first paragraph dele *which*.
251 and 252, see new leaf at the end.
256, line 6, for *this being allowed, for*, read *this being allowed for*,
257, in the heading of the article, for *to suit this kind of traffic*, read *to suit the kind of traffic*.
— same article, line 8, for *not only is*, read *not only in*.
261, just above the theorem, for *mercurial*, read *numeral*.
288, Pneumatic Railway, for *Mr. Pinkers*, read *Mr. Pinkus*.

PRICES OF RAILWAY SHARES.

Those finished are marked (1); in progress (2); which have their Bills, but are not begun (3); others (4).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum paid.	Closing Price of Shares in London Markets on: Aug. 30.	September 2.	6.	9.	13.	16.	20.	23.	27.
			£.	£.									
15,000	......	(4) Altona and Lubeck	20	$\frac{1}{2}$									
2,500	......	(3) [illegible]	20	1	$\frac{1}{8}$	$\frac{7}{8}$	1	$\frac{7}{8}$					
		(3) [illegible]	......	5	6	$7\frac{1}{4}$	$7\frac{1}{4}$	$7\frac{1}{8}$	$6\frac{1}{2}$	......	6	$6\frac{1}{2}$	6
9,500	......	(3) [illegible]	......	5	$6\frac{1}{4}$	$6\frac{1}{4}$	$6\frac{1}{4}$	6	6				
7,500	......	(3) Birmingham, Bristol, and Thames Junction	20	1	$\frac{3}{8}$	$\frac{3}{8}$	$\frac{1}{2}$	......	......	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{3}{8}$	
15,000	......	(3) Bristol and Exeter	100	5	......	......	......	......	$4\frac{1}{2}$	$4\frac{1}{2}$			
660	......	Calcutta and Saugur	50	2	$\frac{3}{4}$	......	......	$\frac{7}{8}$					
950	......	Cheltenham..........................	100										
7,500	......	(3) Cheltenham and Great Western...	100	$2\frac{1}{2}$	$2\frac{1}{2}$	......	......	$2\frac{3}{8}$	......	......	......	......	$1\frac{1}{2}$
14,000	......	(4) Cheltenham, Oxford, and Tring...	100	5	......	$3\frac{3}{8}$	......	$3\frac{3}{4}$	$4\frac{1}{4}$	$3\frac{1}{4}$			
2,000	......	(2) Clarence	100	100									
12,000	......	(3) Commercial Blackwall	50	2	$1\frac{3}{4}$	$\frac{5}{8}$	$1\frac{3}{4}$	$1\frac{1}{2}$	......	......	$\frac{7}{8}$	$1\frac{1}{4}$	
8,000	......	(4) Dublin and Kilkenny	100	$2\frac{1}{2}$	......	......	$2\frac{1}{4}$	$1\frac{7}{8}$					
7,500	......	(4) Durham South-West Junction ...	20	3									
60,000	......	(3) Eastern Counties	25	1	$1\frac{1}{8}$	1	$\frac{7}{8}$	1	$1\frac{1}{8}$	$1\frac{1}{8}$	1	1	$1\frac{1}{8}$
		Edinburgh and Dunbar	......	2	......	......	......	......	......	......	1		
5,000	......	(3) [illegible]th, and Newhaven	20	1	......	$1\frac{1}{4}$	......	......	......	$1\frac{1}{4}$	1		
13,000	......	(4) [illegible] Glasgow...........	50	2	......	......	......	......	......	......	$\frac{5}{8}$	......	$3\frac{5}{8}$
2,500	19s.	[illegible]	50										

800	......	Durham Junction	100	10									
2,800	......	(4) Glasgow and Falkirk Junction ...	50	3									
		(2) Grand Junction	100	50									
		(3) Great North of England............	......	2	$\frac{3}{8}$	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$	......	$\frac{1}{4}$			
		(5) Great Northern	100	2									
25,000	......	(2) Great Western	100	20	$35\frac{1}{2}$	$34\frac{1}{8}$	$33\frac{1}{2}$	35	39	$35\frac{1}{2}$	$36\frac{1}{2}$	$33\frac{1}{2}$	34
2,000	......	(2) Hartlepool	100	100									
2,100	......	(3) Hull and Selby	50	5	......	$4\frac{1}{4}$	$4\frac{1}{4}$	......	4	......	$3\frac{1}{2}$		
10,000	......	(3) Leeds and Manchester	100	5	$18\frac{1}{2}$	$18\frac{1}{2}$	18	18	......	......	15	16	$15\frac{3}{4}$
7,000	......	(1) Leeds and Selby	100		......	......	......	4	$4\frac{1}{4}$	4			
1,500	......	(1) Leicester and Swanington	50	50									
5,100	10l. per c.	(1) Liverpool and Manchester	100	100									
		Ditto, $\frac{1}{4}$ shares	25	25									
10,000	......	(4) London and Brighton (Stevenson's)	100	5	$8\frac{1}{2}$	$9\frac{1}{2}$	$8\frac{3}{4}$	$7\frac{3}{4}$	$7\frac{1}{2}$	$7\frac{1}{2}$	$6\frac{1}{2}$	$6\frac{1}{2}$	$6\frac{1}{2}$
45,000	......	(5) ——————— (Gibbs) ...	20	1	......	$\frac{5}{8}$	......	......	$\frac{5}{8}$				
16,000	......	(5) ——————— (Rennie)	50	2	$\frac{3}{4}$	$\frac{7}{8}$	$\frac{3}{4}$	$1\frac{1}{8}$	......	$\frac{7}{8}$	......	1	1
8,000	......	(5) ——————— (Cundy)	100	2	$1\frac{1}{3}$	$1\frac{7}{8}$	$1\frac{3}{8}$	$1\frac{1}{2}$	$2\frac{3}{8}$	$2\frac{1}{4}$	2	2	
12,000	......	London and Blackwall	50	3	$2\frac{3}{4}$	$2\frac{1}{4}$	$2\frac{3}{8}$	$2\frac{1}{8}$	$2\frac{3}{8}$	$2\frac{1}{8}$	$1\frac{7}{8}$	$1\frac{7}{8}$	
		(5) London and Dover	50	1									
30,000	......	(5) London and Gravesend	20	1									
20,000	3l. per c.	(2) London and Greenwich	20	20	$23\frac{3}{4}$	$23\frac{1}{2}$	23	$22\frac{3}{4}$	23	$22\frac{1}{2}$	$21\frac{1}{2}$	21	21
		Ditto, Bonds.		......									
25,000	......	(2) London and Birmingham	100	60	......	......	134	136	......	......	135	......	135
20,000	......	(2) London and Southampton	50	25	$26\frac{1}{2}$	26	25	......	$24\frac{1}{4}$	$23\frac{1}{2}$	$22\frac{1}{2}$	21	$21\frac{1}{8}$
7,000	......	(3) London and Croydon	20	10	$8\frac{1}{2}$	$8\frac{1}{2}$	......	......	$8\frac{3}{4}$	$8\frac{1}{4}$	......	......	$11\frac{1}{4}$
12,000	......	(3) London Grand Junction	50	2	......	$1\frac{1}{2}$	1	$1\frac{3}{8}$	$1\frac{3}{8}$	$1\frac{1}{2}$	$1\frac{1}{4}$	1	1
1,000	......	(5) Manchester and Oldham...........	100	3									
10,000	......	(5) Manchester South Union	100	2	......	$2\frac{7}{8}$	......	......	......	$2\frac{1}{2}$	......	3	3

PRICES OF RAILWAY SHARES (Continued).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum Paid.	Closing Price of Shares in London Markets on Aug. 30.	September 2.	6.	9.	13.	16.	20.	23.	27.
			£.	£.									
		(3) Midland Counties	50	5	......	......	......	4¾					
		(4) Margate and Ramsgate	......	2									
		(3) North Midland	......	5	12¾	12	11¼	10½	11	10½	10	10	9¾
		(3) Northern and Eastern..............	100	3	2¼	2½							
2,500	......	(2) Preston and Wigan..................	......	20									
2,600	......	(2) Preston and Wyre	50	8									
4,000	......	(3) Sheffield and Rotherham	25	3⅛									
1,000	6l. per c.	(1) Stockton and Darlington	100										
1,500	......	(2) Stanhope and Tyne	100	100									
3,000	......	(4) South Durham	50	2½	......	1¼	1⅛	......	......	1¼	......	......	¾
28,000	......	(3) South-Eastern and Dover	......	2	5⅝	4⅛	4¼	4	3¾	4⅜	3½	3¼	3¼
		(4) South Midland	50	1	⅞ ⅝	⅝	⅝	......	......	......	......	⅝	
40,000	......	(4) South-Western (Stevenson's) ...	50	1	¾	......	......	......	......	⅝	⅝		
9,000	......	(3) Thames Haven	50	2½	......	1½	1	......	1⅝	¾	1		
6,600	......	(4) Victoria	25	1	......	......	......	......	......	......	¼	¼	
		(1) Warrington and Newton	100										
6,000	......	(3) York and North Midland	50										

The above, as [illegible] of the [illegible] he prices at the last business transactions. But it is to be understood, that [illegible] Stock [illegible] n the prices a person can sell at, and those he can buy at, the former being less than the latter. The prices obviously inclu[illegible] for the Share; and therefore the difference between them and the price paid on the Share is the premium or discount of the Share. Where there are blanks no business was done. We have carefully corrected the list of the number of Shares wherever we could; but should any errors be left, we shall immediately correct them when pointed out.

THE

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AND

Annals of Science.

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ON INCREASING THE GAGE OF RAILWAYS, HEIGHTS OF THE WHEELS, &c.

By the Editor.

The Great Western Railway Company having announced their intention of increasing, at the suggestion of their engineer, the gage or breadth between the rails above that used by the Liverpool, Birmingham, and other lines, the subject has excited a considerable sensation among railway companies. For it is very evident that if one company adopts one gage and another another, much of the benefits to be expected from this new mode of transit will be entirely destroyed. How is any intercommunication to be kept up? How is it possible that branch lines can be made between the distant parts of great trunks, if they are to use rails of different widths? Are goods, passengers, &c., to be subject to the trouble and delay of unloading, re-loading, and being transferred to different carriages at every change of road, because the parties have thought proper to lay lines of different breadths? As well might the stage-coach be changed every time the horses are changed, or that there is a change of persons in horsing the coach. Where, indeed, will be the boasted utility of rapid conveyance, if the time saved is to be exhausted in changing from one company's line to another's? Travellers know nothing of companies; nor is it fit, or will it be to the interest of the companies, that they should. Suppose a man of business to be travelling, is it to be endured that his time, which is his stock in trade, is to be endured by some half dozen unnecessary delays in changing carriages, and his luggage knocked about and perhaps lost in the changes, merely because the parties, who ought to do every thing in their power to convenience him, had got some crotchets in their heads about an inch or

two of difference in the breadths of their respective lines? But take it he is travelling for pleasure, and has just got a very comfortable place and coach, is he to be turned out of them, and tossed like a football from coach to coach, for such fanciful notions? Who that is once subjected to this inconvenience will risk it a second time? But let us suppose an invalid is the traveller; must such a person, in the midst, perhaps, of an inclement season, at the hazard of his life, get out of a carriage, which, by the expense of his own bodily heat, he has just raised to a comfortable temperature, to expose himself to a cutting wind, and be shifted from his own warm seat to a coach as cold as the external air itself? Presuming no absolute danger would arise from this, which I by no means admit, it is a risk and an annoyance but badly squaring with the loudly iterated claims to support on the principle of public convenience as well as utility of railways.

Extraordinary as it may appear, it does not seem that there is any law to enforce uniformity of breadth in railway lines. The importance, however, of having the gage fixed, and at a breadth that shall combine safety, not only with the velocities we now have, but with what we may fairly anticipate, is so apparent, that great praise is due to Mr. Brunel for mooting the question.

Such, indeed, has been the effect produced, that I have been applied to by several directors and secretaries of railway companies, to give the matter my best consideration. It is in compliance with these wishes that I throw out the following observations, which I do with considerable diffidence, never having had occasion before to turn my attention to this part of the subject; for, like most others, I could not have supposed that so palpable a necessity for uniformity could have escaped the Legislature.

It certainly has always appeared to me that 4ft. 8in., the present breadth between the rails, is too small for very high velocities. In the first place, by confining the breadth to this, the wheels are obliged to be brought under the carriage, and either made very small or the centre of gravity of the carriage raised to a height that would endanger its safety in high winds, great velocities, or sharp curves. Small wheels, too, by turning so much oftener round, bring every inequality in their form more frequently on the rail, and therefore occasion greater shaking, and consequently greater wear and tear. If it be considered that a wheel 4ft. 8in. diameter—which is a high wheel, and within four

inches of the height of the largest wheel yet made, even for the engines—will turn three times round in a single second when going thirty miles an hour, the value of this observation will immediately appear.

High wheels are likewise found, so Wood says, to work with more economy in proportion, if I remember right, to their diameter. Hereafter I shall discuss the rationale of this; but the fact is decisive in favour of higher wheels than are now used.

With respect to the advantage of high wheels in surmounting obstacles, which is so apparent on common roads, the surface of rails is so even and smooth as probably to render it insensible on railways.

One argument against increasing the height of the wheels is, the greater danger of their running off the rails, attributed by some to the acuter angle made by the tire and rails. But if it be true, as it has been over and over asserted, that owing to the conical form of the tires the flanges seldom or ever come in contact with the rails, where is the weight of such an argument? Besides, if there was any danger, why not increase the depth of the flanges? If they were made in proportion to the diameters of the wheels, the objection must cease. Such greater depth, probably, need only be made to the two leading wheels of the engine.

Another argument against greater diameters to the wheels is, their liability to overturn. This objection is much more valid than the preceding, but yet of little value. For the side force requisite to overturn a carriage must be to the weight of the carriage, in a greater ratio than that of the semi-breadth between the wheels to the height of the centre of gravity above the level of the rails. Now, if the semi-breadth of the rails be equal to the height of the centre of gravity above the level of the rails, I find it would require a velocity of at least 200 miles an hour on a curve of only half a mile radius to overturn the carriage.

If the gage or breadth between the wheels be increased, there is no reason why the centre of gravity should be at all higher. In all probability it might be lowered, as the carriage, instead of being above, might be let down between the wheels. Indeed if the wheels, of the carriages at least, be made to run on the axles instead of turning with them, to which I cannot imagine any good objection, with a conical form to the tire the axles may be bent and the bodies materially lowered, which would reduce the chance of oversetting with an increased gage to almost a cipher.

We must not, however, forget that the disposition to overturn does not depend exclusively on the velocity and curve. The wind blowing strongly on the side may form a very powerful auxiliary which it would be unwise to neglect. The influence of the wind will depend on one side area exposed to it. It is very rarely it can ever act on the side with a velocity of 50 miles an hour. By knowing the area, its greatest probable force therefore may be found by our table, p. 95; and the height of the centre of the area above the rails, with the weight of the load being given, its power to overthrow a carriage may be easily computed. But an increased gage will proportionally diminish this power.

While speaking of the wind, I may just observe, that if any advantage is intended to be taken of a greater gage to augment the breadth, and therefore the front area of the carriages, it will, by reason of the greater resisting force of the atmosphere, prove decisive against high velocities, unless at an extravagant expense of power. This is already clearly shown from the article accompanying the table before alluded to.

The objections of most force against increasing the gage of the rails, are those I shall now more particularly examine.

When a carriage, whose wheels are united to the axle, is running on the road, at any sudden bend there would be a disposition, from the adhesion or bite of the wheels on the rails, to twist the axle in its longitudinal direction, independent of the lateral strain. In the carriages this would be of less consequence; but in the engine, where the slightest twist would be fatal to the systematic action of the machinery, it would be of vital importance. It is, therefore, indispensable that the working axles of engines should have such strength that no sensible friction should take place, and yet not be burthened with superfluous weight. With regard to the actual strength, we may observe, that the total twisting or torsional strain which can at any time be on the working axle, can never exceed a force equal to the adhesion or bite of each wheel applied to the circumference in opposite directions. This, therefore, will give for the greatest leverage the middle of the axle.

Now some engineers, looking at this strain and considering that larger wheels must be stouter to have the same strength, imagine that we cannot increase the length of the axle to any extent, so as to preserve its non-flexibility, without encumbering ourselves with a weight that would

carry us to the confines or beyond of practicability. We shall therefore investigate these points.

Let us suppose two bars, of equal length and of the same material, the sections of which are similar. Then, if we imagine a section of each of these bars to be divided into the same indefinite number of similar parts, the powers of corresponding parts in the two sections to resist lateral or torsion fracture will be as the areas of those parts, their leverages from the neutral axes or points, and their tensile forces. But the said areas will evidently be as the squares of the diameters of the sections; and the neutral axes or points, being no doubt similarly situated, the leverages will be likewise as those diametres. Again, because by the experiments of Coulomb the tensile forces are as the elongations of the parts, these too are as the diameters. So that hence the forces of the corresponding parts of the sections to resist fracture are as the fourth powers of the diametres of those sections; and since this is true of any two corresponding parts, it is true of the whole sections. Moreover, because the leverage to produce fracture is directly as the length of the axle, the power to resist it in the section is inversely as this length. Therefore *the strength of any two similar axles to resist the lateral and torsion strain are as the fourth powers of the diameters of the axles directly, and the simple power of their lengths inversely.*

And if we take into account likewise the radii of the wheels, whose leverages will be as their radii, *the strengths of two similar axles, at the circumferences of the wheels, will be as the fourth powers of their diametres directly, and the products of their lengths and radii of their wheels inversely.*

Hence for two similar axles to be equally strong, the forces being applied to the circumference of the wheels, *the squares of their weights must be as the radii of the wheels multiplied by the cubes of the lengths of the axles.*

Suppose, then, that the lengths of the axles and radii of the wheels are respectively increased 50 per cent., that is, if the axle was 4ft. 8in., suppose it increased to 7ft., and if the wheels were 3ft. let them be increased to $4\frac{1}{2}$ ft.; the axle under such circumstances must be $2\frac{1}{4}$ times the weight. This surely cannot be of such very serious amount in so trifling a part of the machinery. Besides, it should be observed that increasing the length of cranks in the working axles would add only so much to the weight of the axles as their lengths are increased; it would not require a particle more strength and substance in the axle, inasmuch as

the whole strain would be determined by the bite of the wheels.

But it will very fairly be observed that the wheels themselves, if of longer radii, must be stouter, to be of equal strength. Let us calculate the quantity of additional weight on this account. It is evident that the strain on the wheels will be in the plane of the wheels, and, therefore, the vertical dimensions of them need not be increased. Now, it is well known, and might very easily be shown from the preceding arguments, if one of the dimensions of a bar remain constant, that when the strain is in the variable dimension to produce a lateral fracture, and applied at the end of the bar, that the cube of the thickness must be as the length, to support an equal pressure at the end. Therefore the *cube, or third power of the weight will be as the fourth power of the length or radius.*

Hence, for 50 per cent. increase in the radii of the wheels, the weight must be about 71 per cent. greater. In round numbers, therefore, by increasing the gage and radii of the wheels 50 per cent., we shall double the joint weight of the wheels and axles of the engine. The other parts need not be increased, unless the cranks are not increased as the radii of the wheels, or a greater tension of strain used.

Consequently, if the weight of the wheels and axle form a third part of the total weight of the engine (which is mere guess work), and the working-wheels are three-quarters of this, their weight, supposing the engine to be 12 tons, will be then 3, and the new weight 6. But, reckoning twenty-eight times the insistent weight for the load drawn, these 3 additional tons on the working-wheels will meet power for 84 tons of additional load. On the principle of economy, therefore, and the power of overcoming inclines, this would pay well, supposing no advantage besides was gained.

I have not taken into account the greater weight of the axles and wheels (if thought advisable to make these greater) in the carriages, because my arguments have been directed chiefly to the engines, and I have not by me any account of the proportional weights of the parts. But the computation is easily made, and I do not augur that the total amount of increase of weight, particularly if the wheels be not enlarged, would be more than a small fraction of the weight of the whole train.

Another object the Great Western Company have in view, which in a commercial and agricultural sense is worth serious consideration. They expect, by increasing the

breadth of their lines, to be able to construct trucks lower, and more safe and convenient than they now are, for the transportation at once of loaded vehicles to distant places, without the trouble and expense of unloading, loading, and warehousing the articles; so that when they arrive at the nearest point there will be nothing to do but to put on fresh horses and take the goods, on the same waggons or carts they were first loaded on, to their destination. This, perhaps, some will say can now be done. So it may; but could any one prudentially place a top-heavy cart or waggon, whose wheels are 5 feet apart, on a truck, whose wheels are only 4ft. 8in., to be whirled along 20 or 25 miles an hour?

On the Axle-tree Friction of Wheel Carriages.

While discoursing of the merits of Mr. Brunel's plan of increasing the breadth of the lines and height of the wheels, the other day, it was observed to me that increasing the dimensions of the wheels relatively to the axles was expected to reduce the axle friction considerably, which is an important element in the friction of trains. Not being able to see it in this light, I was induced to consider it in my return home, and the result in my mind was, that no advantage whatever would be gained in this respect, supposing our present principles of friction to be true. Finding so marked a difference between my own conclusions, on a subject apparently so simple, and those of the gentleman I allude to, I was induced to examine the different authors I have by me touching on the subject. As they all more or less sanction the opinion of the above gentleman, but either without giving any reasons or such as are perfectly absurd, I have thought it advisable to take this opportunity of bringing the matter formally before the scientific world, that it may have that full investigation experimentally, which, from its influence in our present mode of transit, it is entitled to. With this view I shall cite the opinions of the authors alluded to, and then give my own investigation.

Emerson, p. 110 of his "Mathematical Tracts," says: "It may be observed that great wheels and small axles have the least friction." An observation without a reason, which amounts to nothing.

Hutton, vol. ii., p. 601, "Mathematical Dictionary," observes: "If we consider wheels with regard to the friction on their axles, it is evident that small wheels, by turning

oftener round, and swifter about their axles than large ones, must have much more friction." Nothing surely can be more erroneous, if the principle now generally admitted and confirmed by all experimentalists is true, namely, that "friction is independent of velocity." This very law is given as the result of Vince's experiments in vol. i. of the same Dictionary, p. 557.

A third writer, who touches on friction, and indeed is always ready to retail the opinions of others, if likely to be profitable, but who very sensibly happens to be silent on this particular point, says, "the revolution of wheels on axles partakes of the nature of sliding and rolling friction, and holds a sort of intermediate place between the two." Unless the particles of grease or oil, by which the axles are generally lubricated be the rollers, I should be glad to know where there is any rolling between the axle and its box. To me nothing appears but a simple slipping friction.

These authorities evidently say nothing to the purpose. I shall, therefore, simply lay down the principle now generally received, draw my conclusions from it, and hope it will excite the attention of abler hands.

Principle.—"Friction between hard surfaces is proportional to the weight, but independent of velocity or the quantity of rubbing surfaces."

Vince it is known considered that the quantity of rubbing surfaces had something to do in the matter, and that between hard surfaces the less the abrading surfaces, the less the friction. Reason, however, and the experiments of Coulomb, Ximenes, &c., are against him, and it is now generally admitted they are right. Mr. Perkins assures me he has found the contrary to Vince's assertions between steel surfaces.

Now, on the received principle, it is the insistent weight, not the size of the axle, or the velocity with which the wheel revolves, that measures the amount of friction. The friction is also the same whether the axle is fixed and the wheel revolves on it with a given pressure, or whether the wheel rolls on the ground and is pressed by the axle with that pressure. In the case of the wheel revolving on a fixed axle, if F be the value of the friction, W the weight acting at the circumference of the wheel in its plane and perpendicularly to the radius which would just balance the friction, R the radius of the wheel, and r that of the axle, the well-known principle of the lever will give us $F=W\frac{R}{r}$; and if p be the resistance on the centre of the axle of an imaginary

lever, $W+p=F$. Therefore, R and F being constant, W must increase in the same ratio as r does, and p diminish by the same increment that W increases; that is, the pressure on the centre of the axle must be less as the axle is greater. This would be strictly the case, if the wheel revolved on the axle. Reversing it, and the pressure on the centre of the axle, ought, on the principle of leverage, to be the force of traction, which would be less as the axle relatively to the wheel is greater, and would leave the remaining part of the friction to be compensated by a twisting of the axle, or a pressure in the line of traction directly downwards; but if, instead of having recourse to this imaginary leverage, the point of traction be fixed at the bottom of the axle, the whole force to be overcome is obviously the friction, which, by the above principle, is the same whatever be the size of the pressing surfaces, or the size of the axle, other things being alike.

Since writing the above, Mr. Perkins has informed me that he has found, by experience, a marked difference in favour of larger axles, which he very justly attributes to the solid bearings being more easily kept asunder by the lubricating medium. If then we reflect that the friction of the axles in railway trains constitutes, as I am informed, a *very large* portion of their whole friction, it is evident that the increased gage contemplated by the Great Western Company, by compelling them to have larger axles, will also reduce the friction and consequently the expense of transit. Hence it is plain that—in whatever point of view we regard it—an increased gage is desirable. In the three grand desiderata—wear and tear, reduction of friction, and safety in high velocities—there can be no doubt. The only question is the extent to which it will be proper to carry the increase. If we go beyond 7 feet in the gage, the subordinate parts of the engine, that is, the wheels and axles, will be obliged to be made disproportionably heavy, and power must be spent when it will make no adequate return; for what we are most in want of is a better supply of steam. On the contrary, if we do make an alteration, 6 feet seems to be the minimum to which, with our warm anticipations of improvement in engines, we should confine it. I do not know Mr. Brunel's views, but, taking all the circumstances into consideration, I should be more inclined to fix on 6½ feet as a standard, than upon any other.

For want of space I must defer discussing another very important matter before alluded to, connected with this subject, and bearing strongly on it.—EDITOR.

CAPITAL, COST, LENGTH, REVENUE, EXPENSES, PROFIT, &c. &c., OF RAILWAYS, PASSED DURING THE SESSION OF 1836.

By John Thompson, Esq.

To the Editor of the Railway Magazine.

Harwich Railway Office, 26, Austin Friars,
Dear Sir, *Oct.* 20, 1836.

The accompanying statement relative to the Railways, for which Acts have been obtained during the late Session of Parliament, I have been at some trouble in compiling, from the Reports of the Committee of the House of Commons upon the respective Bills. If you think it worth the space it will occupy in your Magazine, I shall be glad if you will insert it in the next number. Some of the results are curious, and as a piece of statistical information it may be valuable.

I am, dear Sir, your obedient Servant,
John Thompson.

Railways for which Acts have been obtained during the Session of 1836, *showing their respective lengths and estimated cost; the number of Tunnels and their lengths; the length of the Planes and their gradients; the number of Curves and their radii; the estimated revenue to be derived both from Passengers and Goods; and the Profit per cent. upon the Capital employed.*

Arbroath and Forfar.—Capital, 70,000*l.* Estimated cost, 69,460*l.* Length of line, 15 miles, 2 furlongs, 38 yards. Cost per mile, 4,548*l.* Estimated revenne from passengers, 2,600*l.* Estimated revenue, from goods, 6,179*l.* Annual expenses, 2,900*l.* Annual expenses per mile, 190*l.* Profit per cent. on capital, 8¼.—There are no planes to be worked by assistant engines. The steepest gradients are 1 in 200; 1 in 261; 1 in 232. The curves are favourable. The smallest radius is upward of one mile.

Aylesbury.—Capital, 50,000*l.* Estimated cost, 45,242*l.* Length of line, 6 miles, 7 furlongs, 66 yards. Cost per mile, 6,545*l.* Estimated revenue from passengers, 3,368*l.* Estimated revenue from goods, 3,360*l.* Annual expenses, 3,000*l.* Annual expenses per mile, 432*l.* Profit per cent. on capital, 7½.—There are no planes to be worked by assistant-engines. The gradients are favourable; the steepest is

1 in 118. The only curve is 13 chains in length, with a radius of 12 chains.

BIRMINGHAM, BRISTOL, AND THAMES JUNCTION.* — Capital, 150,000*l.* Estimated cost, 93,488*l.* Length of line, 2 miles, seven furlongs. Cost per mile, 32,517*l.* Estimated revenue from passengers, 8,664*l.* Estimated revenue from goods, 10,233*l.* Annual expenses, 5,400*l.* Annual expenses per mile, 1,304*l.* Profit per cent. on capital, 9.—There is an inclined plane to be worked by an assistant stationary engine, 7 furlongs in length, with an inclination of 1 in 50; the only other gradient is 1 in 780. The only curve has a radius of 2½ miles.

BIRMINGHAM, DERBY, AND STONEBRIDGE. — Capital, 630,000*l.* Estimated cost, 630,000*l.* Length of line, Main line, 38 miles, 5 furlongs, 22 yards; Branch, 7 miles, 6 furlongs, 66 yards. Cost per mile, 13,570*l.* Estimated revenue from passengers, 46,353*l.* Estimated revenue from goods, 34,160*l.* Annual expenses, 26,838*l.* Annual expenses per mile, 539*l.* Profit per cent. on capital, 8½.—There are no planes to be worked by assistant engines. The gradients are favourable; the steepest is 1 in 304. The curves are favourable. The smallest radius of any one on the general line is 1 mile.

BIRMINGHAM AND GLOUCESTER.—Capital, 950,000*l.* Estimated cost, 889,703*l.* Length of line, Main line, 52 miles, 120 yards; Branches, 2 miles, 4 furlongs, 33 yards. Cost per mile, 16,299*l.* Estimated revenue from passengers, 90,699*l.* Estimated revenue from goods, 65,155*l.* Annual expenses, 52,000*l.* Annual expenses per mile, 954*l.* Profit per cent. on capital, 11.—There are two planes to be worked by assistant stationary engines; one is 1 mile, 3 furlongs, 115 yards in length, with an inclination of 1 in 54; the other is 1 mile, 2 furlongs, 60 yards, with an inclination of 1 in 36: the other gradients are favourable. The steepest is 1 in 300. The curves are generally favourable. The smallest radius is upwards of a mile. There is one tunnel of 440 yards.

BOLTON AND LEIGH.—The Act is merely for the formation of a Branch 550 yards in length, and to enable the Company to raise 60,000*l.* by loan, to purchase the Kenyon and Leigh Junction Railway, and for the purchase of stock and machinery.

BRANDLING JUNCTION.—The Act is merely to facilitate

* The Company have purchased the Kensington Canal for 36,000*l.*, which, with the estimated cost of the railway, will nearly make up the amount of their capital.

the carrying into execution an Act already passed, and does not contain any authority to take land or other property, and no variation is proposed to be made in the present line.

BRISTOL AND EXETER.—Capital, 1,500,000*l.* Estimated cost, 1,330,670*l.* Length of line, Main line, 75 miles, 4 furlongs; Branches, 4 miles, 4 furlongs. Cost per mile, 16,633*l.* Estimated revenue from passengers, 152,348*l.* Estimated revenue from goods, 106,963*l.* Annual expenses, 86,437*l.* Annual expenses per mile, 1,080*l.* Profit per cent. on capital, 11½.—There are four planes to be worked by assistant engines—

First, 1 mile, 1 furlong, 44 yards, with an inclination of 1 in 76.

Second, 2 miles, 198 yards, with an inclination of 1 in 103.

Third, 3 miles, 5 furlongs, with an inclination of 1 in 170.

Fourth, 7 furlongs, 66 yards, with an inclination of 1 in 95.

The other gradients are favourable, the steepest is 1 in 278. The curves are favourable, the smallest radius of any one is half a mile. There are two tunnels, one 160 yards, and the other 1473 yards.

CHELTENHAM AND GREAT WESTERN.—Capital, 750,000*l.* Estimated cost, 743,000*l.* Length of line, Main line, 43 miles, 6 furlongs, 110 yards; Branch, 4 miles, 1 furlong, 66 yards. Cost per mile, 15,500*l.* Estimated revenue from passengers, 83,537*l.* Estimated revenue from goods, 33,892*l.* Annual expenses, 39,143*l.* Annual expenses per mile, 815*l.* Profit per cent. on capital, 10½.—There is one plane to be worked by assistant engines, the length of it is 1 mile, 5 furlongs, 132 yards, with an inclination of 1 in 72. The other gradients are favourable, the steepest is 1 in 292. The curves are favourable, the smallest radius of any one is three quarters of a mile. There are two tunnels, one 2816 yards, and the other 616 yards.

DEPTFORD PIER JUNCTION.—Capital 60,000*l.* Estimated cost, 60,000*l.* Length of line, 3 furlongs, 123 yards. Cost per mile, 134,866*l.* Estimated revenue from passengers, 6,250*l.* Estimated revenue from goods, 1,650*l.* Annual expenses, 2,000*l.* Annual expenses per mile, 4,500*l.* Profit per cent. on capital, 10.—The line is quite level. The radius of the only curve is 682 yards.

DUBLIN AND DROGHEDA.—Capital, 600,000*l.* Estimated cost, 600,000*l.* Length of line, 32 miles, 2 furlongs, 154 yards. Cost per mile, 18,558*l.* Estimated revenue from passengers, 79,949*l.* Estimated revenue from goods, 13,440*l.* Annual expenses, 32,500*l.* Annual expenses per mile,

1000*l*. Profit per cent. on capital, 10.—There are no planes to be worked by assistant engines, the gradients are favourable, the steepest is 1 in 400. The curves are very favourable, the smallest radius of any one is more than 1 mile.

Dundee and Arbroath.—Capital, 100,000*l*. Estimated cost, 99,844*l*. Length of line, 16 miles, 5 furlongs, 90 yards. Cost per mile, 5,651*l*. Estimated revenue from passengers, 16,912*l*. Estimated revenue from goods, 14,654*l*. Annual expenses, 11,377*l*. Annual expenses per mile. 689*l*. Profit per cent on capital, 20.—There are no planes to be worked by assistant engines, a great part of the line is level, and the portion which is not so is 1 in 1000. The curves are favourable, the smallest radius of any one is 1 mile.

Dundee and Newtyle.

Edinburgh, Leith, and Newhaven.—Capital, 100,000*l*. Estimated cost, 99,736*l*. Length of line, Main line, 2 miles, 2 furlongs, 60 yards; Branch, 1 mile, 1 furlong, 135 yards. Cost per mile, 28,612*l*. Estimated revenue from passengers, 17,027*l*. Estimated revenue from goods, 7,167*l*. Annual expenses, 8,686*l*. Annual expenses per mile 2,480*l*. Profit per cent. on capital, 15½. There is an inclined plane, to be worked by an assistant stationary engine, 997 yards long, with an inclination of 1 in 26. The other gradients are generally favourable, the steepest is 1 in 212. The curves are favourable, the smallest radius of any one is 1000 yards. There is one tunnel of 1030 yards.

Gateshead and Durham (Great North of England).—Capital, 1,000,000*l*. Estimated cost, 659,851*l*. Length of line, 34 miles, 3 furlongs, 100 yards. Cost per mile, 19,164*l*. Estimated revenue from passengers, 64,381*l*. Estimated revenue from goods, 18,164*l*. Annual expenses, 36,642*l*. Annual expenses per mile, 1,065*l*. Profit per cent. on capital, 6½.—There is no plane to be worked by an assistant engine. The gradients are generally favourable, the steepest is 1 in 264. The curves are favourable, the smallest radius of any one is 1 mile.

Great Western.—The Act is merely for altering a line of railway already authorised to be made, the cost of the altered line not exceeding the cost of the original line.—There is an inclined plane on the amended line, to be worked by an assistant engine, with an inclination of 1 in 136. The other gradients are favourable, the steepest is 1 in 660. The curves are favourable, the smallest radius of any one is 3 miles.

Hayle.—The Act is merely for altering a line of railway

already authorized to be made, the cost being provided for in the original Act.—There are four inclined planes to be worked by assistant stationary engines—
First, 605 yards, with an inclination of 1 in 9, nine-tenths.
Second, 825 yards, with an inclination of 1 in 22.
Third, 861 yards, with an inclination of 1 in 15.
Fourth, 600 yards, with an inclination of 1 in 7, four-tenths.
The steepest gradients on the other planes are 1 in 75 and 1 in 130. The curves are sufficiently favourable, the smallest radius of any one is 270 feet.

HULL AND SELBY.—Capital, 400,000*l.* Estimated cost, 384,636*l.* Length of line, 30 miles, 5 furlongs, 154 yards. Cost, per mile, 12,523*l.* Estimated revenue from passengers, 36,750*l.* Estimated revenue from goods, 27,560*l.* Annual expenses, 26,347*l.* Annual expenses, per mile, 860*l.* Profit per cent. on capital, 9½.—There are no planes to be worked by assistant engines. The gradients are favourable, the steepest does not exceed 1 in 500. The curves are favourable; the smallest radius of any one is 3 miles.

LEEDS AND DERBY (North Midland).—Capital, 1,500,000*l.* Estimated cost, 1,500,000*l.* Length of line, 72 miles, 2 furlongs, 146 yards. Cost, per mile, 20,737*l.* Estimated revenue from passengers, 186,069*l.* Estimated revenue from goods, 131,539*l.* Annual expenses, 158,804*l.* Annual expenses, per mile, 2,195*l.* Profit per cent. on capital, 10½.—There are no planes to be worked by assistant engines. The gradients are very favourable, the steepest is 1 in 290. The curves are favourable; there is one with a radius of half a mile, but there is no other with a radius less than a mile. There are five tunnels; one of 348 yards, one of 234 yards, one of 258 yards, one of 1,800 yards, and one of 568 yards.

LONDON AND BLACKWALL (Commercial).—Capital, 600,000*l.* Estimated cost, 600,000*l.* Length of line, Main line, 3 miles, 205 yards; branch to the East India Docks, 1 furlong, 47 yards. Cost, per mile, 183,588*l.* Estimated revenue from passengers, 71,517*l.* Estimated revenue from goods, 12,047*l.* Annual expenses, 27,855*l.* Annual expenses, per mile, 8,523*l.* Profit per cent. on capital, 9¼.—There are no planes to be worked by assistant engines; the gradients are favourable, the steepest is 1 in 330. The curves are favourable; the smallest radius of any on the branch is 1,000 yards, and on the main line 1,333 yards.

LONDON AND CAMBRIDGE (Northern and Eastern).—Capital, 1,200,000*l.* Estimated cost, 1,200,000*l.* Length of line, 53 miles. Cost, per mile, 22,641*l.* Estimated re-

venue from passengers, 199,530*l*. Estimated revenue from goods, 91,172*l*. Annual expenses, 116,280*l*. Annual expenses, per mile, 2,194*l*. Profit per cent. on capital, 14½.—There are no planes to be worked by assistant engines. The gradients are favourable, the steepest is 1 in 330. The curves are favourable; the smallest radius of any one is 1 mile. There are four tunnels; one of 300 yards, one of 520 yards, one of 520 yards, and one of 430 yards.

London and Croydon.—The Act is merely to enable the Company to provide a station, and other conveniencies, for the use of a Railway already authorized to be made.

London and Dover (South Eastern).—Capital, 1,400,000*l*. Estimated cost, 1,334,649*l*. Length of line, 69 miles, 4 furlongs, 22 yards. Cost, per mile, 11,850*l*. Estimated revenue from passengers, 251,522*l*. Estimated revenue from goods, 99,065*l*. Annual expenses, 175,293*l*. Annual expenses, per mile, 2,522*l*. Profit per cent. on capital, 12½.—There are 3 planes to be worked by assistant engines; 1st, 4 miles, 88 yards long, with an inclination of 1 in 100, and 1 in 150; 2d, 1 mile, 5 furlongs long, with an inclination of 1 in 100; 3d, 1 mile, 4 furlongs, 44 yards long, with an inclination of 1 in 100. The other gradients are favourable, the steepest is 1 in 330. The curves are generally favourable; the smallest radius of any one is one-third of a mile. There are four tunnels, viz., one of 528 yards, one of 2,706 yards, one of 1,600 yards, and one of 1,040 yards.

London and Norwich (Eastern Counties).—Capital, 1,500,000*l*. Estimated cost, 1,500,000*l*. Length of line, 126 miles, 4 furlongs, 154 yards. Cost, per mile, 11,850*l*. Estimated revenue from passengers, 338,262*l*. Estimated revenue from goods, 164,647*l*. Annual expenses, 150,000*l*. Annual expenses, per mile, 1,185*l*. Profit per cent. on capital, 23½.—There are two planes, with an inclination of 1 in 102, to be worked by assistant engines, one, 7 furlongs, 132 yards in length, and the other 1 mile, 132 yards in length. The other gradients are favourable, the steepest is 1 in 330. The curves are favourable; the smallest radius of any one is half a mile.

London Grand Junction.—Capital, 600,000*l*. Estimated cost, 600,000*l*. Length of line, 2 miles, 5 furlongs. Cost, per mile, 228,571*l*. Estimated revenue from passengers, 90,818*l*. Estimated revenue from goods, 22,741*l*. Annual expenses, 40,000*l*. Annual expenses, per mile, 15,233*l*. Profit per cent. on capital, 12¼.—There are no planes to be worked by assistant engines. The gradients are favourable,

the steepest is 1 in 273. The curves are favourable; the smallest radius of any one is half a mile.

MANCHESTER AND LEEDS.—Capital, 1,300,000*l.* Estimated cost, 1,300,000*l.* Length of line, 60 miles, 5 furlongs. Cost, per mile, 21,443*l.* Estimated revenue from passengers, 115,256*l.* Estimated revenue from goods, 113,707*l.* Annual expenses, 114,481*l.* Annual expenses, per mile, 1,888*l.* Profit per cent. on capital, 8¾.—There are three planes to be worked by assistant engines. The 1st is 4 miles long, with an inclination of 1 in 165; the 2d is 4½ miles long, with the same inclination; and the 3d is 3 miles, 7 furlongs long, with an inclination of 1 in 130. The other gradients are not objectionable, the steepest is 1 in 277. In the first 41 miles, there are 33 curves.

MERTHYR TYDFIL AND CARDIFF.—Capital, 300,000*l.* Estimated cost, 286,000*l.* Length of line, Main line, 24 miles, 4 furlongs; branches, 12 miles, 4 furlongs. Cost, per mile, 7,729*l.* Estimated revenue from passengers, 4,076*l.* Estimated revenue from goods, 40,453*l.* Annual expenses, 8,000*l.* Annual expenses, per mile, 216*l.* Profit per cent. on capital, 12.—There are three inclined planes to be self-acting, one half a mile long, with an inclination of 1 in 20; one 20 chains long, with an inclination of 1 in 18; and the other 68 chains long, with an inclination of 1 in 25. The other gradients are favourable, the steepest is 1 in 73 and one-third. The curves are favourable; the smallest radius of one on the main line is 1,000 feet, and on the branches 800 feet. There are two tunnels, one of 264 yards, and one of 198 yards.

MIDLAND COUNTIES.—Capital, 1,000,000*l.* Estimated cost, 997,180*l.* Length of line: Main line, 56 miles, 154 yards; Branches, 18 miles, 7 furlongs, 11 yards. Cost per mile, 12,460*l.* Estimated revenue from passengers, 129,938*l.* Estimated revenue from goods, 49,482*l.* Annual expenses, 75,000*l.* Annual expenses per mile, 1,000*l.* Profit per cent. on capital, 10½.—There are no planes to be worked by assistant engines. The gradients are generally favourable. The steepest is 1 in 117⅓. The curves are favourable. The smallest radius of any one on the general line is upwards of 1 mile.

NEWCASTLE AND NORTH SHIELDS.—Capital, 120,000*l.* Estimated cost, 106,152*l.* Length of line: main line, 6 miles, 7 furlongs, 146 yards; Branch, 2 furlongs, 13 yards. Cost per mile, 14,712*l.* Estimated revenue from passengers, 16,790*l.*

Estimated revenue from goods, 6,233*l.* Annual expenses, 8,109*l.* Annual expenses per mile, 1,124*l.* Profit per cent. on capital, 12½. There is a plane to be worked by an assistant stationary engine, 400 yards in length, with an inclination of 1 in 15⅜. The steepest gradient is 1 in 180. The smallest radius of a curve on the main line is 1½ miles.

PRESTON AND LONGRIDGE.—Capital, 30,000*l.* Estimated cost, 30,000*l.* Length of line: main line, 7 miles; Branches, 1 furlong, 80 yards. Cost per mile, 4,151*l.* Estimated revenue from goods, 6,633*l.* Annual expenses, 1,500*l.* Annual expenses per mile, 209*l.* Profit per cent. on capital, 17*l.* There are no planes to be worked by assistant engines. The gradients are favourable. The steepest is 1 in 150. The curves are favourable. The smallest radius of any one is not less than a mile.

SHEFFIELD AND ROTHERHAM.—Capital, 100,000*l.* Estimated cost, 90,000*l.* Length of line: main line, 5 miles, 2 furlongs; Branches, 2 miles, 3 furlongs. Cost per mile, 11,803*l.* Estimated revenue from passengers, 14,593*l.* Estimated revenue from goods, 22,659*l.* Annual expenses, 18,626*l.* Annual expenses per mile, 2,442*l.* Profit per cent. on capital, 18½.—There are no planes to be worked by assistant engines. The gradients are generally favourable. The steepest are 1 in 132 and 1 in 470. The curves are generally favourable. The smallest radius of any one is ⅓ of a mile.

THAMES HAVEN RAILWAY AND DOCK.—Capital 450,000*l.* Estimated cost: Railway, 263,694*l.*; Dock, 186,306*l.* Length of line, 15 miles, 4 furlongs. Cost per mile, 17,012*l.* Estimated revenue from passengers, 43,690*l.* Estimated revenue from goods, 78,349*l.* Annual expenses, 40,679*l.* Annual expenses per mile, 2,624*l.* Profit per cent. on capital, 18.—There are no planes to be worked by assistant engines. The gradients are very favourable. The steepest is 1 in 500. The curves are very favourable. The smallest radius of any one is 5 miles.

TREMOUTHA HARBOUR AND RAILWAY.—Capital, 165,000*l.* Estimated cost: Harbour, &c., 91,693*l.*; Railway, 49,850*l.* Length of line, 16 miles, 6 furlongs. Cost per mile, 2,976*l.* Estimated revenue from passengers, 400*l.* Estimated revenue from goods, 12,758*l.* Annual expenses, 4,600*l.* Annual expenses per mile, 274*l.* Profit per cent. on capital, 5.—There is only one plane to be worked by an assistant stationary engine, the length of which is 4 furlongs, 131 yards, with an inclination of 1 in 9. The other gradients

are favourable. The steepest is 1 in 122. The curves are favourable. The smallest radius of any one is 330 yards. There is one tunnel of 190 yards.

ULSTER.—Capital, 600,000*l.* Estimated cost, 539,447*l.* Length of line, 36 miles, 1 furlong, 71 yards. Cost per mile, 14,916*l.* Estimated revenue from passengers, 67,813*l.* Estimated revenue from goods, 25,250*l.* Annual expenses. 36,000*l.* Annual expenses per mile, 1,000*l.* Profit per cent. on capital, 9½.—There are no planes to be worked by assistant engines. The gradients are favourable. The steepest is 1 in 200. The curves are generally favourable. The smallest radius of any one is ½ mile. There are three tunnels; one of 320 yards, one of 570 yards, and one of 310 yards.

YORK AND NORTH MIDLAND.—Capital, 370,000*l.* Estimated cost, 370,000*l.* Length of line: main line, 24 miles, 4 furlongs; Branches, 7 miles, 1 furlong. Cost per mile, 11,700*l.* Estimated revenue from passengers, 44,285*l.* Estimated revenue from goods, 39,253*l.* Annual expenses, 33,415*l.* Annual expenses per mile, 1,056*l.* Profit per cent. on capital, 13½.—There are no planes to be worked by assistant engines. The gradients are very favourable. The steepest being 1 in 664. The curves are very favourable. The smallest radius of any one is 1 mile.

By the above statement it appears that 35 railway bills passed the Legislature during the last session, of which 5 are merely for the alteration of lines already authorized to be made, and 30 for new lines, the length of which is 994 miles, 1 furlong, 90 yards, and the estimated cost of formation 17,595,000*l.*, or at the rate of 17,700*l.* per mile; and the annual expense of working and maintenance 1,571*l.* per mile. The most expensive lines are the London Grand Junction, the estimated cost of which is 228,571*l.* per mile, and the expense of working 15,233*l.* per mile; the London and Blackwall Commercial, the estimated cost of which is 183,588*l.* per mile, and the cost of working 8,523*l.* per mile; and the Deptford Pier Junction, the estimated cost of which is at the rate of 134,866*l.* per mile, and the cost of working at the rate of 4,500*l.* per mile. Of the 30 railways above enumerated, 19 have no tunnels, and the remaining 11 have 27, the length of which is 11 miles, 7 furlongs, 35 yards, or, upon an average, 775 yards each. Of these tunnels 5 are upon the Leeds and Derby, of the length of 3,208 yards; 4 upon the Northern and Eastern, of the length of 1,770

yards; 4 upon the South-Eastern, of the length of 5,874 yards; and 3 upon the Ulster line, of the length of 1,200 yards. The most objectionable curves are upon the Manchester and Leeds line, of which there are 33 in a distance of 41 miles, and most of them of small radius. The curves upon the other lines are generally favourable. Of these 30 railways, 17 have no inclined planes to be worked by assistant engines, either stationary or locomotive; the remaining thirteen have 24 planes to be so worked, of which 3 are upon the Manchester and Leeds line: the first is 4 miles long, and the second 4½ miles, both of them with an inclination of 1 in 165; the third is 3 miles, 7 furlongs in length, with an inclination of 1 in 130. The steepest inclined plane is upon the Tremoutha Railway, the length of which is 4 furlongs 131 yards, with an inclination of 1 in 9. The Newcastle and North Shields Railway has a plane 400 yards long, with an inclination of 1 in 15⅝. And the Merthyr Tydvil and Cardiff has 3 short self-acting planes, with inclinations of 1 in 18, 1 in 20, and 1 in 25 respectively. The Eastern Counties, the Dundee and Arbroath, and the Sheffield and Rotherham lines have established the best traffic cases; the former showing a clear profit of 23½ per cent. upon the capital employed, the next 20 per cent., and the last 18½ per cent. Of all the long lines yet projected, the Eastern Counties is the cheapest, and shows the greatest amount of traffic.

THE ORIGIN OF THE BRIGHTON RAILWAY AND WATERLOO BRIDGE.

By the Projector of the Liverpool and Manchester Railway.

To the Editor of the Railway Magazine.

Sir,

As through my petition to Parliament, inserted in your last number, you have called me before the public as *the Projector of the Liverpool and Manchester Railway*, I hope I may not be charged with egotism or vanity in answering your call, particularly as, being the projector, amongst other important works, of the Brighton Railway and the Waterloo

Bridge—two measures which I have always considered *naturally* connected.

The Brighton Companies are now demonstrating their intentions of having another Parliamentary campaign, the necessity of the public receiving prior information on this almost absorbing subject is urgent, and, I trust, a sufficient apology for this address.

Having projected the measure, perfected the surveys, lodged the plans and sections, and completed the preliminary Parliamentary business of the *Liverpool and Manchester Railway*, in 1822, I came to London in January, 1823, to demonstrate the importance of the engine railway system, and to acquire and employ amongst my friends in the high circle of life an interest to meet the avowed opposition of the Earl of Derby, the Bridgewater Trustees, and other powerful landed projectors; for private interest, as well as contempt of the measure and calumny as to my motives, hostilely met me in all shapes and directions; but those noble personages, the Earl of Whitworth, Lord Redesdale, and some other eminent persons, justly estimated my motives and intentions. The subject was, however, generally pronounced visionary.

With a view to extend the knowledge and influence of the improved system with the least possible expense and labour, (which was a vital consideration, as it was my misfortune to work *gratuitously*,) I surveyed and planned an engine railway line from London to Brighton and Shoreham, and from Portsmouth to Chatham and Rochester; and early in 1823 I prepared and published an Essay and Report upon the public benefits which would result from that measure, of which 150 copies were gratuitously printed and distributed amongst the members of Government, great land proprietors, principal miners, and commercial men. This pamphlet (of which I present you with a copy reserving the copyright, as a new edition with notes is in the press), with the plan described, the line intended for the improvement of agriculture, of the extensive wastes, and the iron trade and mining interests, and recommended railways on the most economical principles.

This was the first work written on the subject; and having discovered and settled as practicable an improved system of railway communication, I followed with a missionary's zeal (but not with a missionary's salary) the strong impulse my mind had received to serve mankind by its universal introduction; and though it may be my fate to linger a few years

longer a cheerless life in neglect and poverty, I, however, possess the consoling reflection, that my gratuitous labours, though ruinous to myself, have been pre-eminently beneficial to others—that immense wealth, honour, and even glory itself, have been acquired by individuals at Liverpool, Manchester, and Birmingham—that the interest of the landowners, miners, and iron-masters, have been greatly increased—that a change, in a great degree, has been effected in the state of Society—and that blessings innumerable and unlimited have been, or will be thereby diffused to the whole civilized world. For this soul-saving satisfaction, a man should be resigned to live in a garret and die in a ditch. But, Sir, the latter event has not yet occurred. I owe to mankind the benefit of two other discoveries alluded to in my petitions; one which will prove, in my estimation, of far greater value than the engine railway system. I hope to live to perfect, as *an example*, or sample, at Newhaven, and the other in Lancashire, as soon as from my own miserable resources I can find funds for models, surveys, and subsistence.

But return we to the principal object of this address. This pamphlet refers to my report as engineer employed by his late Majesty and others on the improvement and drainage of Lambeth Marsh, in 1806, and for which a main communication is recommended, whose base line was taken in continuation of Tottenham-court-road, passing through Covent-garden, Beaufort-buildings, from thence *by a bridge* over the Thames, and then over the drained marsh lands to the present termination near the Obelisk. *This was the original project of the Waterloo Bridge*, whose position was, unhappily for the public, removed a small distance eastward, and thereby this grand line of communication was destroyed. At the south end of this bridge my line of railway to Brighton commenced, and it was followed nearly over the same country, by Croydon, Mertsham, as far as near Nutfield, by the line suggested by Sir John Rennie, I hear, in 1826. I had continued my line as far as *Worth*, but the country between that place and Brighton appeared much broken by ravines, and as by following the Portsmouth line I conceived some expenses might be saved, *I united the two lines* by Copthorne, Rowfant, Crawley, and Tilgate and St. Leonard Forests, in the hope of inducing the erection of a large and populous town upon this junction.

From Holinbush my line continued and passed near Nut-

hurst, Bramber, above Shoreham, to within 1¼ mile of Brighton; at which place, by means of a machine I had invented, and a discovery I had made, I hoped to cause an harbour to be formed.

Looking to the objects I had then in view, I am still of opinion this would have been the cheapest, as well as the best railway communication. But it seems each place is now to have its railway. The results will prove the wisdom.

My projects and pamphlets occasioned my engagement to attend Parliament last session by Sir J. Rennie. Many improvements have, I hear, been made in the recent surveys. This was to have been expected. But does not this prove the wisdom of the Lords in rejecting the bill last session? May not still further improvements and new lights be discovered by another furlough being granted by their Lordships next session? For it should be remembered, that the locomotive engine power is as yet only a successful (though a most important) experiment, having on a large scale been introduced for about six years only, when, like the car of Juggernaut, it crushed the body of poor Mr. Huskisson; and, on the faith of this experiment, I am an advocate for cheap railways, except on main and principal lines. Is it wise that millions should be voted, and the face of this beautiful country be scarified and tattoed by cuts and batteries, when these expensive works may, and probably will, in great degree, be rendered unnecessary, in many situations, by further inventions and discoveries? Where is the prudence of the enormous expenditure to obtain a velocity of 50 or 60 miles per hour, when lines with gradients afford a velocity of 20 to 25 miles per hour may be obtained at so much less expense? Surely (by powerful engines with larger wheels, or some other contrivance, on these gradient lines) those persons who require such extreme speed may be indulged at an *extra expense*, whilst the more *numerous* and sober-minded class may be content with a velocity of from 20 to 25 miles per hour. In many cases speed increases danger. Why are the lives of the *many* to be endangered by the indulgence of the few? There are *six* different kinds of railways, adapted each to its particular purpose and situation, and *four* modes of working them. On this subject I will venture hereafter to trouble you with my ideas.

But, Sir, one main object in my address, the terminus at Waterloo Bridge, yet remains to be noticed; and if you will

refer to the plan of London, you will be convinced that the central position of Waterloo Bridge points it out as the natural outlet of the great bulk of the respectable population, which is located between lines drawn north from the Tower and from the Penitentiary. This consideration will, I trust, have its weight with the projectors of the southern railways.

My main communication from Tottenhm-court-road to Waterloo Bridge may yet be completed, the terminus of the Birmingham Railway will insure this event.

The unfortunate shareholders of the Bridge may even yet learn and pursue their true interests. Another value contemplated at its origin by its projector has not yet been developed. It may now become a valuable property, if the spirit of the shareholders could be roused from their present lethargy, but the opportunity, if not embraced, may, in the ensuing session of Parliament, be lost for ever.

The metropolis has increased and is still increasing northward and westward. The new railways, the manufacturing districts, and mineral deposits, influence that direction. Mr. Stephenson must remember my opinion emphatically expressed on first viewing and reflecting upon his locomotive engines, "*that its powers were so transcendant, it would work a complete revolution in society.*"

The era is at hand when its effects on society will be apparent. The importance of London as a port will, I fear, speedily and greatly be diminished; much of the coasting trade, and particularly by steam-vessels will, by the railways, become unnecessary; but although much of the heavy work, as casting, &c., will be perfected at the present establishments *near the coal*, yet by the cheap and speedy transit by animate power, which London possesses in an eminent degree, she will, ere long, become, and permanently continue, the Soho of the whole world.

These hasty remarks and suggestions will no doubt receive the attention they are entitled to from a discerning public, and I beg to thank you for inserting them in your Magazine.

I have the honour to be, Sir,

Yours, obediently,

W. JAMES.

Engineer and Land Agent.

York Hotel, Oct. 15, 1836.

ON THE FUTURE IMPROVEMENTS IN RAILWAYS, AND INCREASING THE POWER OF ENGINES.

By the Editor.

Greater caution is hardly needed in any thing than in the construction of future lines of railways, and more especially with regard to expensive tunneling. More than one hint has been given to us of projects being on foot to enable engines to take their loads up much steeper acclivities than they now do, and of course to follow more direct courses in lines as well as to save much of that extravagant expenditure of money in cuttings, embankments, &c., which we now cannot avoid. It is what we have long been anticipating, and the inventive genius of mankind being awakened to its necessity, we feel assured something successful will be effected.

Solely for the purpose of stimulating others to the good cause, we will ourselves give a hint.

Suppose a strong beam be fastened to the under part of the first carriage, and extended beneath the tender to its front. If from this end of the beam a chain or rope be passed over an upright prop a little beyond the axle of the working wheels of the engine, and be fastened, perhaps, to about the middle of the engine; when wanted, this chain may be strained by means of a wheel and ratchet, and the draught made entirely by it in a direction obliquely upwards. The additional weight thus thrown on the working wheels will be to the total horizontal draught as the length of the perpendicular prop is to the horizontal distance of that prop's foot from the said oblique line of draught. By this simple contrivance, we may very easily double at least the weight on the working wheels, and therefore double the engine's tractive power if we have steam enough. One obvious property of it is, that the greater the horizontal strain required the greater the perpendicular pressure; that is, the more work the engine has to do, the more will its power be augmented to do it. A consequence of it likewise is, that we need not have our engines so heavy; and another, that heavy rails would be required in those places only where great exertion is wanted.

In this hasty sketch we cannot of course detail minutiæ, but our chief desideratum will be a plentiful supply of steam. On this head we have some some notions too, which we think would not be altogether useless. We have little doubt

with the same quantity of fuel to be able to generate a vast deal more steam; and instead of that half-guess half-trial method in which engines are now constructed, to reduce all to certain calculable rules, as far as regards just such effects as are wanted.—Ed.

THE ST. PETERSBURGH AND ZARSKOE-SELO RAILWAY.

By Christopher Kreeft, Esq.

To the Editor of the Railway Magazine.

Sir,

Several erroneous statements relative to the St. Petersburgh and Zarkoe-Selo railroad having found their way into the public Journals, allow me, as the established Agent of the Company to inform you, that although the undertaking is under the especial protection of the Imperial Government of Russia, it is conducted by a Company of Shareholders, to whom His Majesty, the Emperor has, by an ordinance dated March 21, conceded most extensive grants and privileges.

The line commences nearly in the centre of St. Petersburg, continues in almost a straight line, and with a medium rise of 1 in 1,028 for about eighteen miles, terminates within the great park of Pawlowsk, much resorted to by the inhabitants of St. Petersburgh, and which, in point of situation, magnificence, and extent, is one of the finest in the world. The terminus at Pawlowsk is a splendid edifice for public entertainment, with a frontage of 350 feet, fitted up with concert and ball-rooms, conservatories, winter gardens, and fountains.

The parallel rails, chains, locomotives, carriages, waggons, turn tables, and other railway machinery, were contracted for in this country, by the Chevalier von Gerstner, the eminent engineer, and are admitted, duty free, into Russia. The rails weigh 65lbs. per yard, and the whole of the machinery is on the newest and most approved construction.

The locomotives are particularly powerful, by reason of the width of the track laid down by Mr. Von Gerstner, being six feet, instead of four feet, eight inches and a half,

which admits of great scope in the general arrangement of the engines, more stability, and considerably lessens the wear and tear. It is perfectly true, that Messrs. R. Stephenson's engine on trial was propelled at the rate of sixty-five miles and a half, and Mr. Timothy Hackworth's at the rate of seventy-two miles per hour. They are provided with an apparatus in advance of the engine for clearing the frozen sleet and snow from the rails, and each carries a trumpet-instrument, performing flourishes and marches with a power equal to that of a brass band.

The line was commenced in April last, and will be opened in the course of the present month of October, a result only attainable in a country like Russia, where the ordinary difficulties of such an undertaking disappear before the powerful patronage of the Sovereign.

The whole line is proposed to be lighted with gas. The traffic on it will be immense.

I beg you will make use of this communication in whichever way you may think proper.

I remain, Sir, your most obedient Servant,
For Christohper Krefft,
Christopher Krefft.

8, *Billiter Street*, *Oct.* 31, 1836.

ESSEX VERSUS KENT RAILWAYS.

By Taffy.

To the Editor of the Railway Magazine.

Aberystwith, *Oct.* 22, 1836.

Sir,

I have been given to understand, that on all questions connected with railways, you are a sort of *woolsack authority*—a Court of Chancery personified — to which any poor devil who is in danger of being run foul of in the jostling race after modern improvement, may appeal with confidence for such redress as can be administered by a public and powerful denouncement of injustice.

Now you must know, most equitable Editor, that I am a Kent convert; that is to say, having been a proprietor to some extent in the late Gravesend Railway Company, I consented to be drafted into that of the Kent, having

implicit faith in the honour and respectability of the Directors, and a tolerably good opinion of the scheme itself. This done, I gave myself no further trouble on the subject, but resting quietly at my country box, "far from the madding crowds' ignoble strife," I have lived in the hope of some day or other deriving a fair return for my capital: last week, however, I was startled by an advertisement, purporting to come from a "London, Rochester, and Chatham Railway Company," who propose to establish a depot at Tilbury Fort, for the purpose of invading the county of Kent. "Shiver my timbers!" cried I (for I was a sailor in my youth, and occasionally lighten up my now autumnal visage by "doing a bit of nautical") "here's a go!" and muttering, a la Byron—

> "Did I ever?
> No, I never."

I re-adjusted the spectacles which momentary agitation had displaced, and proceeded to make myself acquainted with the details of this Essex demonstration. Presently I was informed—and if you have any experimental knowledge of hope deferred, you will conceive with what feelings—that all the plans for a railroad on the Kentish side had failed, or "survived with but slender chance of success." Presuming that a positive assertion like this could hardly be made without authority, I forthwith commissioned a friend of mine in town to make inquiries on the subject, and ascertain how the shareholders in the Kent Railway Company were to be disposed of. I have this morning received an answer from my correspondent, stating that he had obtained an interview with the Secretary, and had every reason to be satisfied with the situation of the concern, that its prospects were highly encouraging, and that so far from being apprehensive of a miscarriage, there appeared to be solid grounds for anticipating a happy accouchement at the usual period. My friend adds, "Don't fidget yourself with the allegations of newspaper advertisements, they are lightly made and as lightly estimated." Now, Mr. Editor, my friend's communication, however it may have allayed my anxiety, has, in the same degree, roused my indignation. I have always understood that the right to promote our own interest, is bounded by the obligation to respect that of our neighbour; and I am not aware of any scientific modification of so obviously reasonable a law. Either the concoctors of the aforesaid advertisement have grounds for

their assertion, or they have not. If they have, they are bound, in justice to the unwary, to be more explicit in their statements. If they have not—the wish being father to the thought—they have invested the dreams of their own imagination with the semblance of truth, and hazarded a published assertion, that the views of others are hopeless, merely because they find such views to be an inconvenient obstacle to their own; then I take leave to tell them, and all those who lend their names to the delusion, that they are not one whit less culpable than he who preys upon the public by inventing and propagating falsehood, for the purpose of raising or depressing the value of the funds. Nay, if the degree of guilt is to be determined by the amount of injury inflicted, they must submit to take precedence of the worthy here alluded to, for *his* phantoms vanish almost with the coming day; whereas *theirs* cannot always be met by so prompt a refutation.

I quarrel with no man's *opinions*, provided they are not elevated into an oracular authority, to the deception of some and the prejudice of others; for, notwithstanding the assurance of my London friend, that public advertisements are unattended to, my own feelings tell me that there are exceptions to the rule, and, besides such an argument in no respect lessens the criminality of their authors. For example, it *may* be *my opinion* that the Eastern Counties' scheme presents but a rueful prospect for its proprietors, and that the only* *leg* it has to stand upon—the branch to Thames' Haven—will prove a very rickety adjunct. But, if I did so *think*, I should hardly feel justified in palming the visions of my brain upon the public for *fact*, and thereby, perhaps, shaking the confidence of those who, under an opposite conviction, have staked their property in its support. So these Essex adventurers may *think* what they please—that the Kent Railway is a chimera, and those concerned in it doomed to disappointment. Of this I complain not. On the contrary, I will heap coals of fire upon their heads, by heartily wishing them success in their ingenious attempt to emulate the *weeping willow*, by shooting branch after branch down into the river. All I desire is that crude and undigested *opinions* may not be stamped with the impress of *fact*; that fancy may not usurp the place of reality; and that, if the Eastern Counties and Thames Haven

* Our Correspondent is mistaken. The Eastern Counties has more branches than one. There is a company already formed for one branch more to Harwich, and others are forming.—ED.

have any favourite object in view, they will not stoop to effect it by misrepresentations injurious to others.*

I beg your pardon, Mr. Editor, for troubling you with so long a yarn, and possibly I ought to do the same for the *tone* in which I have drawn up and submitted my case to your judgment, but, as puss says to her lord and master in a print which one of our booksellers has just received from London,—"I am offended, Tom," and write warmly.

Peradventure, my communication is altogether unpublishable, and in that case you are at liberty to consign it to that bourne whence no penmanship returns in perusable condition; or peradventure, No. 2, you will weed it of all that is not exactly "comme il faut," and then let it figure in your pages for the benefit of those who, like myself, may have been misled by this fulmination from Essex.

Mr. Cundy again!—I have seen an announcement in the Papers of a proposed railway to, and harbour at, Sandwich, projected by this *miso-Tunnelist*, and there are names appended to the Committee, closely allied to our enterprising Essex friends. Is there here more than meets the eye? and can you give me any information on the subject?

I am, Mr. Editor, your humble servant,

TAFFY.

CITY AND RICHMOND RAILWAY.

BY NO SHAREHOLDER.

To the Editor of the Railway Magazine.

SIR,

IN the Supplement to a late Number of the Mining Journal I perceive the Editor appears to throw some doubts over the success of this project. I am no shareholder myself in this line, nor do I care one straw whether it succeeds or not; but, being a man of leisure out of business, I am one of those who amuse themselves with watching the concerns of others; and of late I have particularly looked at the railway projects, as furnishing the most fruitful and popular subjects of amusement. Many of these are exceedingly good and many are exceedingly bad. The City and Richmond is certainly not one of the latter. On the contrary, if

* Our respectable Correspondent is again under mistake. The Thames Haven has nothing to do with the "London, Rochester, and Chatham" Company. We believe this project is not at all pleasing to them.—ED.

my judgment is worth any thing, it stands high among the former. My opinion is not given from mere conjecture, but from actual facts. I have lately, Sir, had an opportunity of becoming acquainted in part with the traffic on that line, which the Company are now taking; and I can assure you it far surpasses any thing you could reasonably conceive. I am not alluding to the traffic the line may receive from the six or eight railways it is said to take up from, for of this I know nothing. I am only referring to that which may be said to be exclusively its own. The whole traffic of this line consists of passengers, the most lucrative of all traffics; and, if the Company will only know their own interest well enough to be satisfied with moderate charges, such are the prospects of the line it will be difficult to fix a limit to their revenue. You will pardon me, Sir, for so invading your time; but though an idle and an uninterested man, I love justice.

As an anti-tunnelist, Sir, I suppose it will be no slight recommendation to you that this line avoids two tunnels on the Birmingham line of 2¼ miles.

No Shareholder.

[The Plate, accompanying this Number, of the proposed terminus at Richmond, shows that the Company intend to proceed like men who have confidence in their concern.—Editor.]

REVIEW OF BOOKS.

Fisher's Views in the Holy Land.—We have already given our testimony in favour of the two first numbers of this work. The third is not a whit behind them, whether we regard the spirit and beauty of the plates, or the warm enthusiasm of the writer. We must, however, confess that, much as we admire the "forest in its glory and gloom," and the "haughty cliffs shrouded with fragrant shrubs," in the "Scene on the River Orontes," we are far better pleased with the "luxuriant gardens" of Tripoli, "intermingled with houses extending over the whole plain to the sea," and still more with the gay and lively views of Antioch, with its "everlasting mountains," and the warlike scene at Beteddein Palace. Though we think the breadth a little too much cut up occasionally, yet the animation of the scenes in detail is excellent. The 4th, 5th, and 6th Nos. of this interesting work, which no man of taste should be without, have just reached us. We shall notice them early.

SCIENTIFIC AND MISCELLANEOUS INTELLIGENCE.

Evaporation.—Bishop Watson, by an experiment on a close-mown grass-plat, and after a long period of dry weather, found that the quantity of vapour given off invisibly in 12 hours of a summer's day, amounted to no less than 2,720,000 gallons on a single acre, or about 1,600 gallons of water. Such is the gigantic scale on which nature silently and unostentatiously performs her operations.

Animal Temperature.—It is a curious fact that men of all nations and tribes, and of all climes; whether they feed on herbs, flesh, milk, or pulse, have very nearly the same bodily heat, that is, 37° 1 Centigrade or 99° Farenheit. This heat, however, is a trifle augmented when a man is transported to a cold, and on the contrary diminished when transported to a hot climate. Birds have the greatest bodily heat, mammiferous animals next, then man, amphibious animals, and some insects.

Continuous Bearing Rails.—J. Binns, Esq., Secretary of the City and Richmond Railway, is about to lay down a mile of his new patent continuous bearing rails, on the Greenwich line. We have a high opinion of this invention, and shall be happy to see its operation.—Ed.

Perkins's New Locomotive Engines.—Mr. Perkins is constructing some locomotive engines with his new—we think we may call them everlasting—boilers, to bring to a decisive test on the Southampton railway. If the invention succeeds, we shall have no trouble hereafter about incrustations, nor the consequential dangers of bursting.—Ed.

North-West Passage.—It is said Government contemplate sending out, next summer, another expedition to attempt the north-west passage. If Government intends it as a matter of curiosity, well and good; they may as well spend some money that way as any other. If they have utility in view, they had better try to find the philosopher's stone. Suppose a north-west passage was found, where is the *cui bono?* It might look well on our maps and globes, and make a pretty tale for another Scott; but would it be traversed once in a century?

High Velocities with Canal Boats.—In the *Mining Journal* of October 18, are detailed some interesting experiments on the Ardrossan or Paisley Canal. In the Forth and Clyde, experiments were several months back made, by fastening together two single gig-boats, making what is called a twin-boat, and it was found that the quicker the boat went through the water the less was the wave or surge. The consequence was, the building of a twin-boat of a

my judgment is worth any thing, it stands
former. My opinion is not given from me
from actual facts. I have lately, Sir, h
becoming acquainted in part with the
which the Company are now taking;
far surpasses any thing you could
am not alluding to the traffic the
six or eight railways it is said t
know nothing. I am only re
said to be exclusively its o
line consists of passengers,
and, if the Company will
enough to be satisfied w
prospects of the line it
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As an anti-tun
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[The Plate
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EDITOR.]

MISCELLANEOUS INTELLIGENCE.

by an experiment on a clear
period of dry weather, found
in 12 hours of

oars,
the middle; or, in
to be between the blade
the concave part of the blade
at will then, contrary to the usual
the oars push the water backwards; the
thereby being directed to the objects they are
without the difficulty of continually turning their
behind them. By this plan, the oars will be shorter
the blades and the rowlocks, and still more so in the part
projects, thus being more out of the way of objects. It
, however, be necessary for the oars to project a little on the opposite sides of the rowlocks, and perhaps to be loaded with a little lead, in order to balance them, and prevent unnecessary labour in raising them out of the water.

When sculls are used, the rowlocks may be nearer to the centre of the breadth of the boat, an obstacle may, however, then be caused by the balancing portions of the sculls interfering with each other's motion. But by making one of the rowlocks a little higher than the other, or by some other simple contrivance, it is hoped that this may be obviated.

The power necessary to apply to these oars or sculls, to produce the same effect as with common ones, will be the same as with them, provided the distance of the hands from the rowlocks, and the rowlocks from the blades of the oars, &c., be the same, as it

on which side of the object to be moved the power is
arc described by the hands being the same in both
that of the blades if free. If these methods, how-
less agreeable to the rowers or the other pas-
boats for dangerous places they may not be

n relates to the rowlocks themselves, and is
ars or sculls when, by unskilful rowing or
ntact with any object so as to injure the
ss of motion and noise.
se purposes made separate from the
to which the oars or sculls must fit
n necessary for the feathering of
to the boat by an axle going
at the rowlocks shall turn with
eing provided with a stop,
the oars, and to be easily

hopes experience will

ompertz has also, with de-
and practical men, the following
ips and boats, with a view to increase

for ships and boats, to give them speed, would
ave been long ago discovered by theory as well as
; yet the shapes adopted do not seem the best for this pur-
e. The front and the hind parts of vessels ought *not, it appears, to be alike, nor nearly so* (as they now are), for the very simple reason that their offices are quite contrary to each other: the prow ought to impress the water as little as possible, while the stern should offer as much resistance to it as possible; therefore the prow cannot be of too acute an angle, nor the stern too obtuse a one. The latter, indeed, should not, it appears, be angular at all, neither perpendicularly nor horizontally; but should offer a broad flat surface, or rather a concave one for the water to press against, and thus powerfully push the vessel on.

In order to see the action of the water, fill a long pan with bird-seed, instead of water (the effect of which is very similar, though not precisely so), and place a piece of wood in it of the shape of the vessels here recommended, but the action will be best seen if the front part be only made taper sideways, and is not bevelled from the bottom. Then gently move this piece of wood forward, and it will be seen that the front part pushes the seed forward by the angular part more and more as far as the base of the angle; during which the seed rises into a hill before it on each side, until the square part of this vessel reaches these hills, when the swell of seed begins to descend, and retrograde till it reaches the stern,

and then it makes a sudden and forcible turn again, striking the stern with great power. There two streams are clearly seen, and the seed (or back-water) behind it can also be clearly seen closely following them up and adding greatly to this effect. This is the action of the surface, below which it must be somewhat different; but the lower seed or water must, it appears, also participate in the action, because it helps to fill up the vacancy which the vessel is continually leaving behind it.

The reason for preferring a concave to a flat stern is, because a concave one better prevents the two streams from escaping sideways, or from coming into collision with each other, and destroying each other's motion, before they fall in the vacancy left by the vessel.

If, then, water and bird-seed act similarly, the effect it is presumed will be as is here anticipated; but the superior fluidity of water requires the experiment to be on a larger scale, and water will then show more of the minutiæ than bird-seed, and it will then also be seen that circles and other curves are formed in the water by the meeting of the different currents, which cannot be shown by bird-seed, but only a small part of the water will be thus affected.

Locomotive Steam Engine.—Messrs. R. and W. Hawthorn, the eminent engineers of this town, have just completed, for the Newcastle and Carlisle Railway Company, a new locomotive steam engine. The engine is estimated at a power of about 40 horses. The machinery was put into operation at the extensive works of Messrs. Hawthorn, on Wednesday, the 12th, a large party of ladies and gentlemen having been invited to witness its first performance. The company, amounting to 80 or 90, included many engineers, architects, and others familiar with mechanical subjects. These scientific gentlemen had been attracted to the spot, from a desire to examine a new and vastly improved arrangement, invented by Messrs. Hawthorn, of the hand-gearing for working that portion of the mechanism called the slide valves. The ease and rapidity with which the motion of the engine was reversed by the man in charge of it, elicited the opinions of competent judges that the arrangement is as simple and perfect as the nature of the motion will admit. On Thursday the engine was conveyed to Blaydon, and made her first trip to Hexham in a highly satisfactory manner. It was ascertained that, in one part of the journey, she ran over a mile of ground in one minute—being at the rate of 60 miles an hour. It should be observed that her burden in this experimental trip consisted of only one carriage of passengers; but she had to contend with the opposing force of a strong west wind. At this tremendous speed it was with difficulty that the persons in charge of the engine could keep their places on the tender.—*Newcastle Journal.*

Heat received from the Sun.—The actual amount of solar heat

derived from the sun annually by the earth, has been estimated to be sufficient to melt a coat of ice encompassing the whole globe, and 14 metres or 15·3 yards thick.—*Whewell's Report on Heat, &c.* p. 31.

If thus, as Dr. Black observes, 140° of heat be lost in the liquefaction of ice, the whole annual solar heat received would raise a coat of water, surrounding the whole globe, of 11·9 yards thick, from the temperature of freezing to that of boiling. Or, accounting it 12 yards, and the pressure ½lb. per square inch for every foot, the above crust of water is equal to about 44,000,000,000,000 tons nearly.—ED.

Railway Coaches.—There is now just completed at Mr. Jeffery's coach manufactory, Gray's-inn-road, some railroad coaches, intended for a railway at the Island of Cuba, of a very superior description. The sides are so constructed that they may be used entirely open from end, or used with large plate glasses, and for bad weather, Venetian spring blinds, all working in grooves. Each will carry 18 persons. In order to keep the roof from the heat of the sun, an additional canopy is placed at some distance above. The under carriage parts are constructed with a peculiar combination of springs, which prevent the shock of the carriages striking each other, being in the slightest degree felt by the persons inside. The communicating bars pass through a succession of brass bearings, accurately turned, and prevent any noise; and the carriages are painted a very rich amber, relieved with crimson lines. From the peculiarity of their construction, they are the strongest and most commodious vehicles ever built for the conveyance of passengers.

Level of the Land and Sea.—Mr. Whewell, at the late meeting of the British Scientific Association, urged the propriety of making observations to fix the relative level of the land and sea, for prosecuting which a sum of 500*l.* was then voted. The object of Mr. Whewell is to ascertain whether the land at various places is permanent, or rising, or falling. No doubt can be entertained of the great interest of such an object. Mr. W., however, raised the question how this was to be ascertained—from the mean level of low or mean tides. Our opinion is, it should be from the mean height of the water—in the same way as we reckon from the mean height of the barometer—supposed to be taken every moment during a complete period of all the courses disturbing it, which is about 18 years.

Old Thermometer.—Mr. Babbage exhibited a thermometer at the same meeting lately discovered in Italy, and supposed to have been manufactured for the Societte del Cimento. It appeared to be filled with alcohol, with a spherical bulb, and its stem divided into fifty equal parts by brads, attached to it by fusion. There were no fixed points, so that nothing can be known of its actual indications.

Effects of Prices of Corn on Births, Marriages, and Deaths.—At the same meeting the Baron Dupin stated that from 1815 to 1832, corn in France had fluctuated from 84*s*. to 34*s*. per quarter. An increase of 100 per cent. in the price, he observed, produced very little effect on the number of births or deaths; but in marriages, during the year of greatest scarcity, there were 918 marriages less in a million. Years of the greatest abundance, however, were not productive of the most marriages; but years when the prices were near a medium. Lord Nugent observed, that while the population of France was increasing, the number of births were stationary; which Baron Dupin accounted for by the increased intensity of life.

Rivers running from the Sea into the Land.—Lord Nugent, at the above meeting, mentioned some sea rivulets in the bay of Argostoli, in the island of Cephalonia, which flow from the sea to the land, and one of them had been used to turn a mill. Many notions had been started to account for this curious phenomena. Some supposed a difference of level on different sides of the island, and that these rivulets restored the equilibrium through a subterraneous tunnel. Others, that the sea went into the interior of the earth, and mixing with inflammable bodies produced volcanic phenomena. But it is one of those phenomena which, as Davy used to say, was reserved for a future age.

Supply of Water to Paddle Wheels.—Mr. Robinson mentioned an experiment to prove that the water which supplies the paddle wheels comes neither from the surface nor sides of the stream through which the wheels move, but from the under water. He proved it thus:—He moored a steamer in deep water, and having strewed the water all round for a considerable distance with sawdust, and then setting the engine in motion, he observed that the sawdust every where, except immediately behind the wheels, was perfectly quiescent.

Dimensions of the Mammoth.—In the museum at Philadelphia is the skeleton of the mammoth, or great mastadon, discovered in the state of New York, 1801. The dimensions of this stupendous animal are as follows:—Height over the shoulders, 11 feet; over the hips, 9; length from the chin to the rump, 15; and from the point of the tusks to the end of the tail, following the curve, 31—in a straight line, 17 feet 6 inches. Width of the hips and body 5 feet 8 inches; length of the longest vertebra, 2 feet 3 inches; of the longest rib, 4 feet 7 inches; of the tusks or horns, 10 feet 7 inches. Circumference of one tooth, 1 foot 6½ inches; weight of the same, 4lb. 10oz.; and weight of the whole skeleton, 1000lb.—*Mining Journal.*

PROGRESS OF RAILWAY WORKS.

CHELTENHAM AND GREAT WESTERN UNION RAILWAY COMPANY.

First General Meeting of the Proprietors.

In consequence of the apparent merits of this line, and the severe contest it had in Parliament, we have devoted a much larger space to its report and first meeting than we are accustomed to do on such occasions. We, however, hope the importance of much of the matter elicited, particularly relative to Mr. Brunel's increased gage, will be ample apology.—Ed.

At a general meeting of the Cheltenham and Great Western Union Railway Company, held in pursuance of the Act of incorporation, at the Masonic Hall, in Cheltenham, on the 6th October, 1836, William Henry Hyett, Esq., in the Chair, the following report was read:—

Report of the Directors of the Cheltenham and Great Western Union Railway Company, to the proprietors assembled at the first general meeting, held in the Masonic Hall, in Cheltenham, on Thursday, the 6th October, 1836.

On the 13th October last, a public meeting, called by advertisement in the newspapers, was held at Cheltenham, at which it was unanimously resolved, that "An Act having been obtained for making the Great Western Railway, it would be productive of important advantages to the town of Cheltenham, and to the agricultural, manufacturing, and commercial classes of the city and county of Gloucester, that a railway should be established from Cheltenham to join the Great Western Railway at or near Swindon, in the county of Wilts."

A Company was formed by the unanimous voice of that meeting, and your Directors were appointed to carry into effect the above resolution.

They took immediate steps to fulfil the direct objects of their appointment, and notwithstanding an opposition which protracted their proceedings in London nearly five months, they have now to congratulate you upon having carried their instructions into full effect.

Your Directors would have convened this meeting at an earlier period, but they thought it their duty, in the first place, to close all their out-standing accounts, so as to be able to lay before the proprietors the exact state of the finances.

The long and complicated contest in which they have been engaged has necessarily created some delay in the accomplishment of this object. They have, however, in the meantime occupied themselves in making the necessary preparations for carrying the

Act into effect. Having now paid all demands on the Company, with the exception of the balance of one disputed bill amounting to 240*l.* 11s. 4d., they have only to render you an account of their stewardship, and to resign into your hands the powers confided to them.

With respect to the funds entrusted to them, they have to state, that having paid every claim whatever on the Company up to the passing of the Act, with the exception of the balance before referred to, out of the deposit of 2*l.* 10s. per share, there still remains a balance in hand.

The following balance-sheet, presents a correct abstract of the accounts, arranged under the usual heads of expenditure:—

STATEMENT.

Receipts.

Amount of capital received being deposits on 7,500 shares, at 2*l.* 10s. per share............				£18,750	0	0

Payments.

Engineering, including surveyors, land valuers, and professional witnesses in Parliament............................	£3,885	8	9			
Parliamentary agent and fees ...	1,748	16	7			
Solicitors' bill, including fees to counsel, and other law-charges and disbursements...	8,207	10	0			
Parliamentary expences, including witnesses, hire of committee-rooms, canvassing, observing road traffic and other disbursements	2,223	13	3			
Local agents' charges and disbursements	983	5	7			
Printing and advertisements ...	210	7	9			
General disbursements, consisting of office expenses, salary to secretary, stationary, postage, travelling and incidental expences	265	6	6			
Balance in hand	1,225	11	7			
	£18,750	0	0	£18,750	0	0

Reports having been circulated that your Directors have contracted large debts, in addition to the above expenditure to the alleged expense of 20,000*l.* to one Company alone—their reply is,

they have borrowed nothing, nor have they received any pecuniary assistance from any party, or in any shape whatever.

They have been enabled to meet and overcome all obstacles, mainly in consequence of the judicious selection of the line with reference to the combination of important interests benefited and accommodated by it, and though they have encountered an opposition more severe and protracted than any other railway in the last session of Parliament, except that from London to Brighton, they believe they have obtained your Act of Parliament at a much smaller expense than has been incurred in any other undertaking of the same extent which was opposed at all, by maintaining from the beginning strict economy in the administration of the finances entrusted to them; and they feel it an act of justice to state most distinctly, that to your Engineer and Solicitor, both for their general able conduct of your affairs, as well as for the moderation of their charges, the Directors have been thus enabled to limit their expences to the above-mentioned sum.

In order to avoid a collision with the Birmingham and Gloucester Company on that portion of the line between Cheltenham and Gloucester, which was claimed by both Companies, and feeling that their real interests were identical, and that mutual aid and cooperation were material to the welfare of both, your Directors entered into an agreement with them to participate in the costs and profits of that portion of the line. They continue to feel as they have ever done, the great importance of the Birmingham and Gloucester line to this undertaking, and anxiously desire the complete success of that work.

Your Directors deemed it expedient, in conjunction with the Directors of the Birmingham and Gloucester Company, to purchase the Cheltenham tram-road for the sum of 35,000*l.*, one moiety of which sum is to be paid by each Company, the tolls on which now pay 6½ per cent. upon the purchase-money.

Your Directors, pending the opposition in the House of Commons, under the urgent advice of the counsel for the Bill, were induced to enter into an agreement to pay to the Thames and Severn Company 7,500*l.*, and a like sum to an influential proprietor on the line, as a compensation for damages to be sustained by those parties, and in consideration of their withdrawing their opposition.

The Directors were also under the necessity of entering into engagements with some landholders, pending the proceedings in Parliament, for the purchase of land, compensation for severance and and otherwise, which engagements throughout the line, however, only cause an increase of about 6,000*l.* beyond the actual total valuation originally made by the Company's surveyors.

In making the above explicit statement of the prospective engagements of the Company, in addition to the actual state of the finances, the Directors consider that the exaggerations which have been circulated afford a sufficient ground for this departure

from ordinary usage on similar occasions, and that it would be better to err upon the side of unreserved exposure of the state of your affairs, than to leave any appearance of mystery on this part of the subject.

Your Directors have further to report, that they have secured the valuable superintendence of Mr. Brunel in the construction of the railway,—under his directions the operations of permanently setting out the line is in active progress, and your Directors are happy to state on his authority, that he will be enabled to introduce several improvements affecting the general character of the line, both as regards the gradients and the curves, and that the objectional curve in the proposed tunnel at Sapperton, will, as was stated in the evidence before the House, be avoided.

In connexion with such improvements, the Directors may refer also with satisfaction to the very favourable gradients on the whole distance, and particularly on the Great Western Railway between London and Swindon, they find that the speed will be so materially increased beyond their expectations, that with such engines as are now actually in construction for the Great Western Railway, the journey between Cheltenham and the metropolis may be performed in three hours.

All the shares have been subscribed for, and so many and great advantages have been practically experienced by other companies from having an office in London, that your Directors turned their attention to the attainment of that object. This they have been able to accomplish in the most satisfactory manner, and at a moderate expense, by placing the establishment, with the consent of the Directors of the Great Western Railway Company, under the immediate superintendence of their London Secretary, at their Office in Cornhill.

Your Directors have further to report that every examination into the probable traffic on this railway has developed new sources of income.

The evidence given on this subject before Parliament, which was rigorously investigated, will show that you may confidently rely on a much greater return for your capital than was originally held out to you. You may also fairly assume that the estimated annual expenditure will be considerably diminished by the great improvements continually making in the construction of railways, as well as in the application of the working power.

Those who have looked on this as the mere branch railway, briefly described in the Preamble to the Act, take a very limited and superficial view of the importance of this undertaking, either as a work of public utility, or as a profitable investment for capital.

So far from its being a branch of merely *local* importance, it is a portion of the trunk of two great national railways. The one connecting the whole of the North of England with the West and South-west, the other connecting the metropolis and the South of

England with Gloucestershire, Herefordshire, Monmouthshire, and with the greater part of Wales, forming a continuous line of railway connecting the important seaports of Liverpool, Hull, London, and Bristol, with the port of Gloucester, and the increasing woollen and other manufactures of the county. That it may be in the route from Ireland to London is not improbable. The estuary of the Severn presents an insurmountable obstacle to any railway from South Wales towards London at any point south of the direction of this railway.

Your Directors cannot close their report without reiterating their decided conviction, after a deliberate review of every argument adduced against the measure during the long and arduous contest in Parliament, that the general principles upon which this particular line was originally promoted, were sound and good.

Your Directors feel that immediate and energetic measures are necessary to secure the earliest completion of the line to Swindon, against the period at which the Great Western Railway will be completed to that point, which is expected to be opened in the year 1839; and they strongly urge on the proprietors the necessity for their cordial operation and support.

It was resolved unanimously,

1. That the report of the Directors now read is in all respects most satisfactory, and be adopted; and that the cordial thanks of the proprietors be given to them for their unremitting attention and exertions, and for the excellent management of the affairs of the Company.

2. That the following gentlemen be appointed Directors of the Company, pursuant to the provisions of the Act:—

Wm. John Agg, Esq., Edward Barnard, Esq., Devereaux Bowley, Esq., Thos. Crowther Brown, Esq., Raymond Cripps, Esq., Lewis Griffiths, Esq., W. Henry Hyett, Esq., William Lewis, Esq., N. S. Marling, Esq., Charles Stephens, Esq., Henry Norwood Trye, Esq., Joseph Ellis Viner, Esq.

3. That the sum of 800*l.* be paid annually to the Directors to cover their personal expenses, to be applied in the manner they may consider most eligible and conducive to the interests of the Company; to commence from the passing of the Act.

Amendment to the above Resolution, proposed and carried unanimously.

That the sum of 1,000*l.* be substituted for 800*l.*

4. That the thanks of this meeting be presented to the Right Honourable Lord Wharncliffe, and to the Right Honourable Lord Edward Somerset, for the able and impartial manner in which they presided over the Committees in the Houses of Lords and Commons, during a protracted opposition.

5. That the grateful acknowledgements of the proprietors be given to those Members of Parliament whose regular attendance in the Committees materially promoted the interests of the Company.

6. That the thanks of this Meeting be given to J. K. Brunel, Esq., for his exertions on behalf of the Company, and for his able assistance.

7. That the Directors be requested to print their report, and to transmit a copy to every proprietor, with the proceedings of this day.

8. That this Company are considerably indebted to the able and zealous exertions of their solicitors; and whilst they deeply regret the death of Mr. Griffiths, to whose conduct and character they cannot omit bearing the highest testimony, they tender their thanks to Mr. Lawrence for having so well maintained the interests of the Company.

The Chairman having left the chair—

Resolved unanimously—

That the thanks of this Meeting are especially due to Mr. Hyett, for his great and effective exertions in London, during the proceedings in Parliament, and for his able Presidency on this occasion.

BIRMINGHAM, BRISTOL, AND THAMES JUNCTION RAILWAY COMPANY.

A special general meeting of this Company was held at the City of London Tavern, on Friday, the 14th of October, to consider the propriety of bringing a Bill into Parliament, for extending the line from Kensington-crescent to Knightsbridge-green. The project is one which will prove highly beneficial to the western parts of the metropolis, and, taken in conjunction with the new market, about to be established near the proposed terminus of the railway at Knightsbridge, will be peculiarly so to the districts in its immediate vicinity. The proposition gained the instant assent of the proprietors present, and, upon the draft of the proposed Bill being read, a resolution was unanimously passed that it should be presented to Parliament in the ensuing session.

We subjoin the report of the Directors to the Proprietors, recommending the extension of the line:—

Report.

The convenience which passengers from the north and west of England must derive from a railway transit, continued to the immediate neighbourhood of Hyde Park-corner, has pressed itself so forcibly on the attention of the Directors of this Company, that, after mature consideration of the most eligible line for such a work, of the obstacles as well as facilities which may attend its construction, and of the total expense of its completion, they have thought it their duty to make the following report to the proprietors at large.

It appears, on the most careful examination, that the most eligible line for the objects contemplated, would be from the north side of the Hammersmith-road, through Kensington-crescent, by

the open field and garden-ground on the north of Brompton to Knightsbridge-green, which would thus become the terminus of this Company's railway. By this extension, the traveller coming from the Great Western or Birmingham Railways, would be brought to a spacious, open, accessible landing-place, frequented by public conveyances of every kind, and situate within less than half a mile of Piccadilly, instead of ending his railway journey, as he otherwise must end it, at the remoter points of Paddington or Somers-town; and independently of the advantage of this proximity, the Directors are persuaded that a large proportion of travellers would adopt the Knightsbridge route, were it only to avoid the two tunnels which must be encountered by the Somers-town approach.

The suggested extension of the line presents peculiar facilities in an engineering point of view. The levels are such as to obviate all difficulty in crossing the roads, while the necessity which the construction of the works will impose on the Company of deepening and straightening the intervening sewers, will materially improve the drainage, and consequently the healthiness of the district.

The railway is proposed to be depressed below the general surface, so that either by walls, or by fences, it may be wholly or partially masked, as may best suit the wishes of the proprietors and occupiers of the land which it may intersect.

From Kensington-crescent to Montpelier-square, which is within 300 yards of the proposed terminus at Knightsbridge-green, no important obstacle presents itself, as the railway will interfere with not more than three or four houses, and those not of a costly description; and although at and from Montpelier-square to Knightbridge-green itself, the number of buildings to be removed, and consequently the cost of proceeding will necessarily be greater, yet the Directors believe that the whole of this property may be obtained at a moderate rate, some portion of it indeed being already in the market.

A very important and favourable consideration is, that for upwards of one-half of the whole length of the proposed extension, the line will pass over the property of Lord Kensington, who is a warm supporter of the undertaking. And, as far as their inquiries have yet gone, the Directors are not aware that any of the owners of the property upon the line are likely to offer any serious opposition. In fact, it will cut through no large property except Lord Kensington's.

Proceeding upon the most liberal computation, the Directors are persuaded that a new capital of 75,000*l.*, in addition to the sum which the Company is already enabled to raise, will more than cover the entire expense of purchases, compensations, constructions, and every other contemplated outlay both immediate and contingent; and will put the Company in possession of much property, which daily improving in value, will yield them a considerable in-

come independent of their tolls. It is proposed to raise this additional capital of 75,000*l.* by the issue of 3750 new shares of 20*l.* each.

On the whole then, after an examination the most attentive and cautious, the Board are unanimously of opinion that there are no difficulties in the execution of the line, as proposed to be extended to Knightsbridge-green, which may not be effectually surmounted, —that the probable cost, compared with the great importance of securing a terminus so close to London, is not such as to make the undertaking a matter of hazard, and that the direct communication which will thus be effected between the whole north and west of England, and the wealthiest of the streets and suburbs of the metropolis, (the communication with the Thames being already secured by the existing Act,) is likely to produce an accession to the revenues of the Company much larger than proportionate to the outlay.

The Directors have great pleasure in congratulating the shareholders upon the completion of arrangements with the Great Western Railway Company, by which that Company have agreed to form a station for the express purpose of connecting their line with this railway, and upon the amicable and cordial feeling which subsists on all points with the Great Western as well as the London and Birmingham Railway Company, the present railway forming the sole connecting link of their respective lines with each other, and with the Grand Junction Canal and the river Thames.

Statement of Receipts and Expenditure.

	£.	s.	d.
Dr.			
To Deposit of 1*l.* per Share, on 6,072 Shares	6,072	0	0
To Interest on Exchequer Bills.................	5	1	3
Cr.	6,077	1	3
By Payments, as per Abstract	4,972	5	10
Balance at the Banker's	£1,104	15	5

Abstract.

Salaries	244	0	0
Advertisements	369	12	10
Office Disbursements, including Agency	271	12	2
Printing and Stationery	185	7	7
Legal and Parliamentary expenses	1,162	16	0
Engineering and Surveying	1,267	17	0
Office Furniture	171	0	3
Kensington Canal Company	1,300	0	0
	£4,972	5	10

26, *Austin Friars*, *Oct.* 14, 1836.

WILLIAM GUNSTON, Chairman.
HENRY LUARD, Deputy Chairman.

RAILWAY NOTICES.

The Brighton Railways.—Every party seems to be busily employed, and strengthening himself by all the alliances in his power, like crafty politicians preparing for a desperate struggle. The candidates for the honour of accommodating the Brightonians amount to five: Mr. Stephenson's, Sir John Rennie's, Mr. Mills's (late Cundy's), Mr. Gibbs's, and Mr. Provis's, starting from the South-Eastern line at Godstone, we believe. The wisdom of our often iterated recommendation to the Legislature last session, to throw out the lines, that a better than either would be found, is now most amply verified. Those who maintained last year that they had the *very best* which could be found, now say they have far better, and therefore better than the best. Probably, if they were again thrown out, instead of the comparative superlative, another year would find them the superlative superlative, and the Brightonians would be favoured with such a line as the sun before never shone on.—Ed.

Great North of England Railway.—We congratulate our readers, who are shareholders in this great national undertaking, which, by means of its connexion with the York and North Midland, the North Midland, Birmingham and Derby Junction, or the Midland Counties' Railroads, may justly be regarded as the *present* northern terminus of the London and Birmingham Railway, *until* the contemplated line from Newcastle-upon-Tyne to Edinburgh shall have united the two metropolises by a continuous line of railway, as the Board of Directors for the Great North of England line of railway are already proceeding in the formation of contracts for an economical execution of the work. We also learn, from the best authority, that surveyors have for some weeks past been busily employed in surveying the line through the various estates, preparatory to making purchases.—*Liverpool Mercury.*

Eastern Counties' Railway.—The first general meeting of the shareholders of this Company was held in London on the 26th ult. It appeared from the balance-sheet that the deposits received on 61,676 shares, with interest, amounted to 61,845*l.* 2s. 9d., out of which the Company have a balance in hand of 25,283*l.* 3s. 7d. The Chairman (H. Bosanquet, Esq.), stated that there was every probability of the eventual success of the undertaking, and of its being an ample source of remuneration to the proprietors, because it was founded upon the broad and stable basis of national utility. —*Birmingham Herald.*

England and Ireland Union Railway.—On Wednesday last

(Oct. 12), a public meeting was held at the Tolsey, in this city, agreeably to previous notice, for the purpose of taking into consideration the expediency of promoting a line of railway from Gloucester to Fishguard, or a terminus on the western coast of South Wales. The Mayor of Gloucester was called to the Chair. Our reporter has furnished us with a full report of the proceedings, which were of a desultory nature. The feeling of the meeting was decidedly in favour of this important national undertaking. A local Committee has been formed.—*Gloucester Chronicle.*

Greenwich Railway.—This Company is now receiving upwards of 50*l.* per diem for traffic, and on Sundays upwards of 150*l.*, though passengers have to walk from London-bridge to Bermondsey-street. Fifty pounds per diem make 18,250*l.* per anunm, the interest at 4 per cent. of 456,250*l.*, nearly the capital of the whole line. Considering passengers have to trudge from London-bridge to Bermondsey-street, and are then set down at Deptford, this may give a tolerable idea of what may be expected when the whole line is opened. "Why is it not opened?" the public repeatedly asks. We have inquired, and we cannot find.—ED.

Gloucester and Birmingham Railway.—The shares in this Company appear more to be sought after than for some time past, owing, no doubt, to the prospect of a great increase of traffic thereon from the many branch lines which are likely to be connected. Borings are making at Mosely, with the view to ascertain the nature of the soils through which the excavations will have to be taken.—*Birmingham Advertiser.*

Gloucester and Bristol Railway.—The Committee of the Gloucester and Bristol Railway have unanimously determined to prepare for Parliament in the ensuing session. A most important point was, whether or not the Cheltenham and Great Western Union line should be used as far as practicable, or an entirely new line out of Gloucester be laid down. It was decided in favour of the Cheltenham and Great Western Union line, which saves the necessity of making from seven to eight miles of additional railway.

Gloucester and Hereford Railway.—The Engineers have made their Report on the eligibility of the different lines through Ledbury and Ross, and a Resolution has been passed by the promoters, that they earnestly recommend the support of the landholders and capitalists of the county of Hereford be given in aid of the line of railway proposed to be taken *via* Ledbury, with a branch to Ross; and that the several bankers of the city of Hereford be requested to receive deposits for shares.—*Hereford Times.*

Great Western Railway.—We are happy to inform our readers there is no foundation for the rumour that the works of the Great Western Railway have been intercepted by a strike among the workmen. They are proceeding most satisfactorily: no less than two thousand five hundred men are now employed on the con-

tracts between Bristol and Bath. A slight check was given to the works on Wormwood Scrubs, on account of this and the Birmingham, Bristol, and Thames Junction Railway meeting and crossing on the same level, but that also is obviated by an amicable arrangement between the two Companies.

Hull, Lincoln, and Nottingham Railway.—The engineers have just completed their survey of this line, and have discovered a gorge in the Lincolnshire Wolds, near Melton Ross, which seems formed by nature for the level of a railway. It will not now be necessary to skirt the Humber by Ferriby Sluice, Barton, &c., and the expense of walling up the foreshore will be saved.

Hull and Selby Railroad.—The Directors are pursuing the most vigorous means to carry into effect every thing connected with the formation of the railroad from Hull to Selby. The length of the railroad is thirty miles and three quarters, from the junction with the Leeds and Selby Railway, near Selby, to the quay of Hull Dock. In the whole of this length there will be no rise or inclination exceeding 1 in 500, excepting the approach to the bridge of the Ouse, which is very short, and will be 1 in 250: upwards of twenty miles may be said to be perfectly level. The Committee of the House of Commons deduced from the evidence, "that no line in England, of similar extent, is better adapted for a railway."—*Halifax Guardian*, Oct. 15.

Junction of the Basingstoke and Great Western Railways.—Last week a new measurement was made near Albion-place, Reading, for a new direction for the junction of the Basingstoke with the Great Western. Should it be carried into effect, a tunnel will be required from Whitley-crescent to the back of the intended new hospital, or across Red-lane, leading to White Knights.

Direct Kentish Railway, without a Tunnel.—A meeting was lately held in London for the purpose of establishing a new Railway Company, to be called as above. The line is to be from London to the Docks and Port of Sandwich, *via* Greenwich, Eltham, Foot's Cray, Farningham, Wrotham, Malling, Maidstone, Charing Wye, Canterbury, and intermediate places, with branches to Gravesend, Rochester, Chatham, Tunbridge, Tunbridge Wells, Ashford, and Deal, to meet the Margate and Ramsgate Railway at Sandwich.—*Kentish Observer.*

Kent Railway.—A model of the manner in which this line is intended to pass Greenwich-park has been exhibited and is considered satisfactory and unobjectionable.

Kilmarnock, Irvine, and Ardrossan Railway.—We are glad to find that our merchants are showing, by the alacrity with which they are subscribing to this proposed undertaking, that they are sensible of the great advantages to this flourishing town which will arise from its completion. Several country gentlemen, having property in the neighbourhood, have also adhibited their names to the subscription list for a considerable number of shares. These

are the best guarantees for the success of the undertaking, and are worth ten times the amount of speculative subscriptions.—*Kilmarnock Journal.*

London, Salisbury, Exeter, and Falmouth, Railway and the South Western Railways are both preparing to go into Parliament. Of course there will be a contest for the victory.

Limerick and Waterford Railway.—We feel great pleasure in being able to state that this long contemplated railway, for which an Act of Parliament has been already obtained, is likely to be commenced almost immediately.—*Limerick Star.*

Newcastle and North Shields Railway.—There is, we are glad to observe, some appearance of a desire to proceed vigorously with the construction of this work. The Directors are advertising for tenders "for cutting and embanking on that part of the railway from Carlisle-square, Newcastle, to the bridge across Willington Dean, distance 4 miles. Also the building of the several bridges (Ouseburn excepted), culverts, drains, and other masonry, on the same part of the line." These operations are expected to be commenced in earnest in December or January next.—*Tyne Mercury*, 4th Oct.

A railroad from London to Oxford is said to be in contemplation, by way of Uxbridge, Beaconsfield, Wycombe, and Thame. A meeting is intended to be held soon, at Oxford, to take the scheme into contemplation. Does not the Great Western accomplish all that is here wanted?

Railroad Shareholders' Liabilities.—It has been stated that the new Parliamentary regulations will compel *original* shareholders to be always liable, whether they have parted with their shares or not. We know of no such change, and if there was, we believe it must pass the three Estates regularly, before it can become law. It has even been held by Lord Eldon that such is the law of the land; but we think it too absurd to be law, or to pass any legislature. Why are men to be prevented from selling what they have fairly bought? Why not prevent the baker from selling his flour—the butcher his meat?

Railways.—Numerous railways are now in projection, in addition to those already formed and in operation. Among the schemes submitted to public approbation in the county of Northumberland, there are two, bearing upon the Great North of England line, one by the East coast from this town to Berwick, and so on by Dunbar, to Edinburgh; the other direct through the county, from Newcastle by the river Reed to Jedburgh, and from thence to Glasgow and Edinburgh. Which of these two lines may ultimately be adopted, the plans of each party advocating them are yet too crude to enable us to judge.—*Newcastle Journal*, 8th Oct.

Sheffield and Midland Railway.—This projected railway owes its origin to the North Midland, leaving Sheffield at five miles

distance; that town having opposed the North Midland on that ground, as well as that a line to pass through or near to Sheffield would be practicable if time was allowed for further surveys. Though the North Midland Bill was passed last session, the Committee of the Lords came to a resolution, in some degree sanctioning the above scheme, by which Sheffield would have a railway direct to London and Birmingham, while, to the passengers of the North Midland, nine or ten miles would be saved in the distance to London, by passing over a part of the line to the Midland Counties' Railway, in preference to going round by Derby, as intended by the Act of the North Midland. Mr. Locke has been joined to Mr. Leather in taking minute surveys preparatory to an Act being applied for in the ensuing session.

Sheffield and Goole, and Sheffield and Humber Railways.—These are two rival schemes of communication with the Eastern Ocean; both branch from the North Midland, near to Rotherham; the one terminating at Goole, the other passing over the Ouze, near that place, and joining the Hull and Selby Railway, on the other side of the river.

Sheffield and Manchester Railway.—A meeting of the Committee of this railway, at which Lord Wharncliffe presided, was held on Friday week, at Penistone. Mr. Vignoles and Mr. Locke made their separate reports. Each engineer had found a good line, practicable for locomotive engines. The time which each calculated would be occupied in transit was about the same—two and a half hours for passengers, and three hours for goods. The two plans appeared so nearly equal that the Committee could not decide which was preferable, and therefore desired the engineers to consult together, and agree upon a line which they could both recommend. Another meeting will be held in a few days to receive the report.—*Mining Journal.*

Shropshire Railway.—We are happy to state that the important measure of establishing a railroad to this town from the Liverpool and Birmingham Grand Junction, near Wolverhampton, which was received with such general and cordial approval by the meeting, held at the Town-hall, on the 20th ult., is in a state of satisfactory progress, so far as respects the completion of the plans and surveys; and that, if a sufficient number of the inhabitants of Shrewsbury shall come forward as shareholders, there is no obstacle likely to impede the early attainment of an object universally admitted to be of the utmost importance to the prosperity of the town and neighbourhood, and without which we must expect to witness the decline of all our local interests before the rivalry of other more spirited and enterprising communities.—*Salopian Journal.*

Sunderland and Durham Railway.—The half yearly general meeting of the proprietors of the Durham and Sunderland Railway was held at Sunderland, on Tuesday, September 26, Thomas Pemberton, Esq. in the chair. The Directors' Report for the last

half year was read. It appeared that the sum originally estimated as the expence of the undertaking would have been sufficient for the purpose, provided no additional works had been entered upon. But in consequence of the formation of some branch railways leading from the main line to more adjacent collieries, which would send their produce to Sunderland, and, by making a part of the line a double line of railway, which was not originally contemplated, the total cost would amount to 142,000*l.*—*Newcastle Journal*, Oct. 1.

Telegraphs on Railways.—It is said to be in contemplation to establish a system of telegraphic communication, both by day and night, on the great railroads now in formation, more particularly on the London and Birmingham, and Grand Junction lines. —*Evening Journal.*

Telegraph between Liverpool and London.—We understand that it is probable that a telegraph will be constructed along the line of the Grand Junction and London and Birmingham Railway, for the purpose of communicating commercial information and information connected with the management of the railway from London to Liverpool and Liverpool to London. The plan of such a telegraph has been formed by Lieutenant Watson, of the Liverpool and Holyhead telegraph; and it is, therefore, not unlikely that in three or four years we shall not only be able to travel to London in ten or twelve hours, but to receive information from London in as many minutes.—*Liverpool Mercury.*

Whitby and Pickering Railway.—This railway has now been opened some months, and has hitherto more than realized the hopes of its projectors. The traffic generally has exceeded their calculations, and the number of passengers particularly has been greater, in proportion to the previous communication, than on any other railway. The exact number which was conveyed along the railroad in July was three thousand nine hundred and three; and in August about four thousand two hundred.—*Hull Packet.*

A preliminary meeting of the inhabitants of Abergavenny was held on Wednesday, and was attended by J. T. Heslop, Esq., a member of the Committee of the England and Ireland Union Railway Company, through South Wales, when arrangements were made for holding a meeting of the landowners, occupiers of land, and inhabitants of Abergavenny, on Friday next, for the purpose of considering the best means to be adopted for promoting a communication by railway between that town and Gloucester.—*Birmingham Herald.*

FOREIGN RAILROADS.

Russian Railroads.—We have just perused the Chevalier von Gerstner's "Second Report" on the progress of the line from St. Petersburgh to Zarskoe-Selo and Powlowsk. It is dated Sept. 10, and announces the delivery at St. Petersburgh of the major part of the rails, chairs, carriages, &c., from England, and the intended partial opening of the line upon the arrival of the locomotives, which were shipped in September, and expected about the 8th or 10th October. The construction of this line, eighteen miles in length, carried upon an embankment about nine and a half feet high, including forty bridges, one of which upon a larger scale is thrown over the canal encompassing the town, will thus have been effected in less than seven months, an achievement unparalleled in the history of railroads, and reflecting the highest credit on the directing engineer M. von Gerstner. The grand building within the Imperial park of Powlowsk, for the entertainment of the better classes of St. Petersburgh with its conservatories and fountains worked by a steam-engine of eight-horse power, is in rapid progress towards completion, and two other stations are in course of construction. We learn also that a second line of railroad from St. Petersburgh to Peterhoff, about twenty-six miles, also an Imperial park and palace, and the site of numerous country residences of the nobility, gentry, and merchants of St. Petersburgh, is to be commenced in the spring and finished by the 1st July ensuing, after which two other lines from Moscow to Colomna, and from Riga to Mitau, are to follow. "For a term of ten years this railroad company is to be exempted from taxes of every kind." Here is an example to our British engineers, and to our legislative and parochial governments. A railroad of eighteen miles, some of the materials for which have to be contracted for and brought a distance of near 2,000 miles, is begun and finished in seven months, about one-third the time it would have taken us to procure an Act and get the land conveyed; and at an expense of only 7,500*l.* per mile, a little better than one-third of our average cost. Scarcely would the ground here be staked out before our greedy authorities would be for laying on their taxes and rates "thick and threefold;" but this line is to have a total exemption for ten years! Instead of throwing every obstacle in the way of going through such a place as Greenwich-park, for a great national work, the Imperial Government of Russia generously throws open one of its most valuable private retreats, on which the Emperor lays out some 100,000*l.* sterling annually, and only requires that the Company's buildings shall not discredit his Majesty's. Would it not be very beneficial to this

country to put our higher authorities under Russian tuition for a few months? The prospectus of this Company is well worth perusal. We sincerely wish our unfortunate Spanish bondholders had had their money in the Zarskoe-Selo Railway.

Russian Avidity for Railway Information.—Thirty thousand copies of M. Gerstner's the engineer's first Report on the Zarskoe-Selo Railway, we hear, were circulated in a few days after it appeared; namely, 20,000 in the Russian language, 9,000 in the French, and 1,000 in the English. As many copies will be printed of the Second Report.

Railway Communication between Montreal and New York.—We are truly glad to see that the anticipations of a flying journey to New York, in which we lately taught the restless public to indulge, are soon to be realized. Swifter boats will almost immediately be employed on Lake Champlain. The railroad line will be completed from Whitehall to Albany, and the journey may ultimately be accomplished in the short space of 20 hours, being an hour less than letters and passengers three short months since used to spend between their departure from Montreal and their departure from St. John's. We subjoin the calculation of Thursday's *Gazette*. The distance from Montreal to New York is 384 miles, which will be effected in 27½ hours, as will be seen from the following statement:—

	Miles.	Hours.	Dollars.
New York to Albany	150	11	2
Albany to Whitehall	72	5	2
Whitehall to St. John's	140	10	3
St. John's to Montreal	22	1½	1
	384	27½	8

This may yet be shortened by improvements that might be introduced, and a journey to New York, by the Hudson, be effected within the 24 hours. But, if the railroad from St. John's to Stanstead be completed, and the line finished from the Province line to New Haven, the time necessary to reach New York might also be reduced to 18 or 20 hours.—*Montreal Herald.*

Great American Railroad.—The projected Railroad from Quebec to St. Andrew's, which has been so liberally forwarded by a grant of 10,000*l.* from Government, is viewed in the United States as of vast importance in a political as well as commercial point of view. A writer in the *New York Express* says of it, "The length of the route does not exceed 250 miles; the estimated expense 4,000,000 of dollars, being at the rate of 16,000 dollars a mile." The writer adds, "It enables the British Government to transport all her troops, munitions of war, &c., with all possible speed, from that important travelling position, Halifax, where the British Government is now fitting up one of the strongest fortifications in the world, to Quebec, Montreal, Toronto, the lakes, and all along

our southern and north-western territories. In five or six days soldiers can be taken from the great military and naval depot at Halifax and put upon the St. Lawrence, from Quebec to Lake Ontario. The difficult and dangerous navigation of the Gulph of St. Lawrence is thus avoided. St. John, in population and wealth being the great outlet of the vast lake, the St. Lawrence country will soon rival New York. The British will also thus have a port where their produce can be sent to and from the West Indies. Military and commercial advantages prompt the British Government, not only to expend 4,000,000 dollars, but 40,000,000 if necessary."—*Falmouth Packet.*

Railways in America.—A project has been set on foot at Boston of a very important and gigantic character—the construction of a railway from Brunswick Harbour, on the coast of Georgia, to the Apalachicola River, or Bay, in Florida. Brunswick is stated to be the best harbour in the southern Atlantic coast, and the healthiest place in the southern states. Sixty years ago, it was recommended as a dock-yard, and naval depot for the South Atlantic Colonies, by the then British Colonial Government. The object of the Company in question is to cut a canal, for the purpose of directing the trade of the Allamanda into this harbour, which opens into a large inland sound, navigable for steam-boats to Charlestown and Savannah in the north, and to St. John's, in Florida, to the south, and connect it by a railroad to the Apalachicola River, in Florida, about 200 miles. This project, when carried into effect, will produce a revolution in the internal trade and communication of the United States, and will enable the merchants and travellers at New York to make an easy passage to New Orleans in six days. The flour, pork, tobacco, and sugar, from the Mississippi, destined for the markets on the southern and eastern states, will then be shipped at this point; while the Apalachicola River will be the place where land transportation will end, and steam transportation begin. The *New York Morning Courier*, alluding to this great scheme, says—

"This railroad, from a good port in the Gulph of Mexico, to the best on the other side, must be one of the most important of any in America. It cuts off from twelve to fourteen hundred miles of dangerous navigation round Florida Cape, and lessens the distance of travelling, with regard to time and extent, one-half. The merchant or other person leaving here, on business or pleasure, will arrive at New Orleans in six days, without riding all night at the hazard of his neck. Boats will run to Brunswick as they now do to Charlestown."

PRICES OF RAILWAY SHARES.

Those finished are marked (1); in progress (2); which have their Bills, but are not begun (3); others (4).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum paid.	Closing Price of Shares in London Markets on: Sept. 30.	October. 4.	7.	11.	14.	18.	21.	25.
			£.	£.								
15,000	......	(4) Altona and Lubeck	20	½								
2,500	......	(3)	20	1	......	1½	......	1¼				
		(3)	......	5	......	6½	......	......	6	......	5½	5¾
9,500	......	(3)	......	5	......	......	4½	......	......	4¼	4	3¾
7,500	......	(3) Birmingham, Bristol, and Thames Junction	20	1	......	⅝	......	⅜	½	......	½	
15,000	......	(3) Bristol and Exeter	100	5								
660	......	Calcutta and Saugur	50	2	1	1	1	......	......	......	......	⅞
350	......	Cheltenham...........................	100									
7,500	......	(3) Cheltenham and Great Western...	100	2½	......	......	......	......	1	¾	1	1¼
14,000	......	(4) Cheltenham, Oxford, and Tring...	100	5								
2,000	......	(2) Clarence	100	100	45	......	......	45				
12,000	......	(3) Commercial Blackwall	50	2	......	1	......	⅞	......	......	1⅛	1
8,000	......	(4) Dublin and Kilkenny	100	2½	......	......	2	......	2			
7,500	......	(4) Durham South-West Junction ...	20	3								
60,000	......	(3) Eastern Counties	25	1	1	1⅛	1¼	1⅛	1⅛	1⅛	......	⅞
		Edinburgh and Dunbar	......	2	......	¾						
5,000	......	(3) Edi ith, and Newhaven	20	1		......						
13,000	......	(4) Edi Glasgow............	50	2		......						
2,500	19s.	For	50									

800	......	Durham Junction	100	10										
2,800	......	(4) Glasgow and Falkirk Junction ...	50	3										
		(2) Grand Junction	100	50										
		(3) Great North of England...........	......	2										
		(5) Great Northern	100	2										
25,000	......	(2) Great Western	100	20	35½	36½	35¼	34½	33	32½	32½	32		
2,000	......	(2) Hartlepool	100	100										
11,000	......	(4) Harwich	20	1	1	1	......	......	1	......	1			
8,000	......	(2) Hull and Selby	50	5	......	......	......	4	......	5	......	4		
2,100	......	(1) Leeds and Selby	100	100										
1,500	......	(1) Leicester and Swanington	50	50										
5,100	10*l.* per c.	(1) Liverpool and Manchester	100	100	......	......	......	......	......	......	14			
		Ditto, ¼ shares	25	25										
10,000	......	(4) London and Brighton (Stevenson's)	100	5	7	8¼	8	8	7¾	7½	7	7		
45,000	......	(5) ———————— (Gibbs) ...	20	1	½	......	......	⅝	......	½				
16,000	......	(5) ———————— (Rennie)	50	2	1	1	1½	1⅝	½	1⅛	1⅞	1		
8,000	......	(5) ———————— (Cundy)	100	2		1¾	2¼				2⅛	2		
12,000	......	London and Blackwall	50	3	......	......	1¾	1¾	1¾	1¾	1¾	1⅜		
		(5) London and Dover..................	50	1										
30,000	......	(5) London and Gravesend	20	1										
20,000	3*l.* per c.	(2) London and Greenwich	20	20	22	24	23¼	24	23½	22½	23	22		
		Ditto, Bonds.		......	......	......	100	......	......	......	99½			
25,000	......	(2) London and Birmingham	100	60	......	130	......	130	125	......	125	125½		
20,000	......	(2) London and Southampton	50	25	21¼	22	22¼	22	21½	21	19½	18½		
7,000	......	(3) London and Croydon	20	10	11	10½	......	10½	10					
12,000	......	(3) London Grand Junction	50	2	⅞	1	......	1	1¼	......	......	1		
1,000	......	(5) Manchester and Oldham...........	100	3										
10,000	......	(5) Manchester South Union	100	2	3¼	3⅜	3½	3¼	3½	......	3¼	3¼		

PRICES OF RAILWAY SHARES (Continued).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum Paid.	Closing Price of Shares in London Markets on									
					Sept.	October								
					30.	4.	7.	11.	14.	18.	21.	24.		
			£.	£.										
		(3) Midland Counties	50	5	......	5								
		(4) Margate and Ramsgate	......	2	......	1								
		(3) North Midland	......	5	10	10	10	10	......	$9\frac{3}{4}$	9	9		
		(3) Northern and Eastern..............	100	3	......	......	1	1	1	......	1	$\frac{3}{4}$		
2,500	......	(2) Preston and Wigan.................	......	20										
2,600	......	(2) Preston and Wyre	50	8										
4,000	......	(3) Sheffield and Rotherham	25	$3\frac{1}{8}$										
1,000	6l. per c.	(1) Stockton and Darlington	100											
1,500	......	(2) Stanhope and Tyne	100	100										
3,000	......	(4) South Durham	50	$2\frac{1}{2}$	......	......	......	......	......	......	$\frac{1}{2}$	$\frac{1}{2}$		
28,000	......	(3) South-Eastern and Dover	......	2	$3\frac{3}{8}$	$3\frac{1}{8}$	$3\frac{7}{8}$	$3\frac{7}{8}$	$3\frac{1}{4}$	$3\frac{3}{8}$	$3\frac{3}{8}$	3		
		(4) South Midland	50	1	......	......	......	$\frac{5}{8}$	$\frac{5}{8}$	$\frac{5}{8}$				
40,000	......	(4) South-Western (Stevenson's) ...	50	1	......	$\frac{1}{2}$	......	......	$\frac{5}{8}$					
9,000	......	(3) Thames Haven	50	$2\frac{1}{2}$										
6,600	......	(4) Victoria	25	1	......	......	$\frac{1}{4}$	$\frac{3}{8}$						
		(1) Warrington and Newton	100											
6,000	......	(3) York and North Midland	50		......	1	......	......	......	......	$2\frac{1}{4}$			

The above, as we have stated, are the closing prices of the day. They are the prices at the last business transactions. But it is to be understood, that there is generally a difference of $\frac{1}{4}$ in the Stock Exchange between the prices a person can sell at, and those he can buy at, the former being less than the latter. The prices obviously include the sum paid for the Share; and therefore the difference between them and the price paid on the Share is the premium or discount of the Share. Where there are blanks no business was done. We have carefully corrected the list of the number of Shares wherever we could; but should any errors be left, we shall immediately correct them when pointed out.

THE

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AND

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No. X. DECEMBER, 1836. New Series.

THE MATHEMATICAL LAWS OF RAILWAY TRANSIT.

By the Editor.

[Continued from page 254.]

Calculation of Velocities.

Returning to our theorem, if $c=\frac{1}{2}$ and $V=40$, that is if the engine has power enough to give a velocity of 40 miles an hour on a level to a train 14 times the weight on the working wheels, (that is 84 tons if the weight on the working wheels be 6,) which must be a pretty good engine, I find by the value of X in (9) it will take ·7 of a mile or near $\frac{3}{4}$ to get up a velocity of 20 miles an hour, or the velocity $v=cV$; and by the whole theorem 2·34 miles, or about $2\frac{1}{3}$ miles to get up the velocity of 30 miles an hour. We see by this that an engine to get up a good velocity within any reasonable limits must be equal to maintain a very superior velocity. It is not, however, to be powerful from weight, but from a capability to generate steam with rapidity. Had $c=\frac{1}{4}$ or $W=7w$ (which makes the load 42 tons, the weight on the working wheels being 6) and V still remained $=40$, we should have found a velocity of 30 miles an hour gained in 1·8 miles. That is with an engine capable of generating only half the quantity of steam—for the power of the engine is measured by the product of the load and ultimate velocity, which is here the same in both cases, 40 miles an hour—we should get up a velocity of 30 miles an hour in 1·8 miles, the load being a half of the former.

Hence a curious consequence. Since the one load is half the other, and the consumption of steam is a half, and therefore we presume the consumption of fuel in equal times is a half, it follows that the wear and tear for equal distances

and the expense of fuel for equal times, are a half the one of the other. But it would appear by the calculations we have made that the lighter load and proportionably less powerful engine would get up a given high velocity in a half a mile less distance, and would therefore, though its maximum velocity be the same as the more powerful engine, do a given distance in less time. Consequently the expense of transport of half the tonnage with an engine of half the power, would be less than half, and done in less than half the time. An argument would therefore at once be drawn in favour of less powerful engines and lighter loads.

This would be strictly true if together with the weight we could reduce the size of the carriages and engine. Unluckily, however, we cannot do this : and when a train is travelling it is found to be very little different, says Mr. Dixon, in a letter to me, "whether it takes 15 or 16, or 50 or 60 passengers." Two circumstances contribute to this : one, the small part of the weight of the whole train, which the weight of the passengers forms, and another, the resistance of the atmosphere. In a train moving at the rate of 30 miles an hour and an exposed surface of 50 square feet, this resistance will add no less than 21¼ tons to the load; which will be very little different whether the train consists of two or three, or six or eight coaches.

Hence we see the necessity, or rather the economy, of having an engine superior to its work. It is a farce to suppose that it is a waste of power to carry an extra weight in the engines unless we can have at our command some such contrivance as that described in p. 368, No. IX., or a better for increasing the bite. Indeed we must, if we wish not to be at the mercy of every obstacle that rises—every little rain or dew that falls—every trifling frost that occurs, be provided with bite enough to overcome them, or sink under the difficulties.

On the Generation of Velocities on Inclined Planes.

In the last part of this paper, No. VII., p. 249 et suis., I have treated of the generation of velocities on levels; but nothing has been said on the subject of inclines. As the omission of this may be considered a fault, I shall here therefore briefly give the theorem, prefacing it with a few observations merely to show the manner in which it is derived. If V be the maximum uniform velocity on a level, and $p=1+\frac{h}{19}$, where h as before equals the inclination of

the plane in feet per mile, positive if the plane is ascending and negative if descending, $\frac{V}{p}$ is the maximum velocity in the plane. At this time therefore $v = \frac{V}{p}$; and since the accelerative force of traction must then $= o$, we have $bwv = vtWp = VtW$, and consequently $v = \frac{tWV}{bw} = cV$ as before. So that the velocity generated by the first part or uniform force is the same on the incline as on the level; it will only require a longer distance and time in getting it up.

Hence we easily find the differential equation to be

$$(V - pv)\, gtdx = v^2\, dv.$$

Integrating this equation and proceeding in the same way as before, we have

$$\left.\begin{aligned} a(x - X) &= \frac{V^2}{p^3}\log.\left(\frac{1 - pc}{V - pv}V\right) + \frac{cV - v}{p^2}V + \frac{c^2V^2 - v^2}{2p} \\ \text{and } aX &= \frac{c^3V^2}{2(1 - pc)} \end{aligned}\right\} \ldots (10);$$

the sum of which two equations gives the value of X or distance run to acquire the velocity v in miles per hour. The latter equation as before is that due to the uniform action of the bite.

After the repeated cautions I have heretofore given not to apply mathematical theorems of velocity to the cases of planes descending more rapidly than full steam can be safely applied to, I need hardly repeat them here for the present theorems.

Owing to the complexity of theorem (10), very little can be said as to its general properties. It is, however, very evident that pc must always be less than unity, otherwise X becomes negative, which is impossible. In the next place, unless $\frac{v}{V}$ exceeds c, and yet the product of it by p is less than 1, the logarithm will be negative, and the sum of the three terms of the first part will be negative, which can only be when the velocity v is less than that due to the distance X.

If we take $p = 2$, that is a plane ascending 19 feet a mile, in which the force of traction is doubled to what it is on a level, and assume, as in the last example on a level, $c = \frac{1}{4}$

and $V = 40$; and suppose v the velocity to be acquired $= 15$ miles an hour, we shall find $x = \cdot 3$. That is in $\frac{3}{10}$ths of a mile the velocity of 15 miles an hour may be acquired ascending a hill rising 19 feet a mile, supposing the total load to be 7 times that on the working wheels, and the maximum velocity on a level 40 miles an hour. Had this 15 miles an hour have been to be got up on a level, it appears it would require only $\frac{1}{5}$ of a mile run to get it up in.

Anxious to conclude the mathematical laws of Transit in the present volume, as far at least as at present I intend to carry them, I cannot now go into further details of calculation.

On Curves, &c., in Railways.—Conical Tires.

Curves, if they are sharp, have long been esteemed among the greatest of objections to lines of railway, in which there is much passenger traffic. It is my intention, therefore, briefly to advert to their properties, and to examine the limits of safety.

Were it not for an ingenious contrivance in the rim or tire of the wheel, curves would occasion an excessive straining and wear and tear wherever they occur; nor would it be very easy to obviate it. But as they are now constructed this is in a great measure avoided, though another evil results from it, the influence of which will I expect one day be found to be more than we now calculate it to be.

In wheels inflexibly fastened to the axle, as they usually are, it is plain that supposing them formed with the greatest care possible, they would only be fitted for perpetually moving in a right line if they were both equal in diameter, or in a continuous curve if they were unequal. If the carriage was endeavoured to be forced out of either of these directions, as the case may be, the flange of one of the wheels would rub up against one of the rails, and the wheels themselves be continually slipping on the rails, occasioning a serious amount of friction, straining, and wear and tear. To the difficulties and increased expense of travelling under such circumstances with any degree of speed, we should soon add that of the destruction of both rails and carriages. But a contrivance has been suggested and successfully put in practice, which is said to obviate the whole. It is by making the tire of the wheels considerably broader than the rails, and instead of cylinders, frustrums of a cone,

the smaller ends being towards the outside of the wheel. By this simple plan, the wheels will either continue a rectilinear course when they are running on similar portions of their circumference, or by the outside wheel driving up its flange a little closer to the rail, and the inner wheel withdrawing its flange a little further from its rail, a portion of the tire larger in diameter in the former case, and less in the latter are brought to run on the rails. So that in this way the outer wheel, while it traverses a larger space, makes the same number of revolutions only which the inner, traversing a less space, does. Consequently if the degree of conicalness is adapted to the curvature of the line of railway, the wheels will follow the curve without any rubbing of the flanges against the sides of the rails or slipping on the rails, and therefore without any straining of the wheels and axles, and needless wear and tear.

For the purpose of rendering this more effectual with little play of the wheels, the rims or tires which are made gradually conical from the outer edge to within a short distance of the flange, rise towards the flange rapidly in a concave section. Wheels by this means having but little play on the rails, will avoid heavy and dangerous lurches from side to side, and at the same time be competent to sharp curves.

Before I proceed to lay down the mathematical rules for this disposition of the wheels, I shall just glance at the effect before alluded to, which will presently I expect make its appearance very visibly in our lines. It is plain from the conical structure of the wheels, that if the upper surface of the rail be horizontal, the whole of the pressure must lie on the inner edge of the rails and be constantly tending to thrust them outwards. This must not only twist the rails out of their vertical position, and thrust them out, but the whole wear and tear being on one edge, and as it were on a line, the wheels themselves must wear in groves and the rails rub away on the inner edge alone, both of which have already happened on the Liverpool line.

Now it is quite evident that the diameters of the parts of the wheels running on the rails, in order to make simultaneous revolutions, and run without slipping, must be exactly in the same ratio as the lengths of the curves they have to traverse. For instance, if r denote the radius of curvature of the inner rail, b the semi-distance of the rails, d the diameter of the circumference running on the inner

rail, and $d+e$ that on the outer rail $r : r+2b :: d : d+e$ and consequently

$$e = \frac{2bd}{r} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

One half of this, e being the difference of diameters, will evidently be the slope or bevel of the rim, agreeably to the play allowed to the wheels. Now in every line it is requisite the wheel should be made so conical, that it may at least go round the smallest curve without slipping. Hence the following

Practical Rule for finding the least bevel of the Tire; the radius of the least curve and play of the wheels being given.

Multiply half the breadth between the rails by the diameter of the wheels, and divide the product by the radius of curvature of the inner rail on the smallest curve, all in feet, and the quotient multiplied by 12 will give the bevel in inches or decimals corresponding to the given play of the wheels.

For example, suppose the curve is half a mile radius or 2640 feet, the diameter of the wheel 4 feet, and the breadth between the rails 5 feet. Then $5 \times 2 \div 2640 = \cdot 003788$, which multiplied by 12 gives ·0455 inch for the bevel, whatever the play may be.

According to the dimensions taken of one of the Greenwich engine wheels by Mr. Habberley Price, C. E., it appears that it bevels off $\frac{1}{4}$ inch in $2\frac{1}{2}$, and has a play of $\frac{5}{8}$ inch. On this play therefore the level is ·0625 inch, which differs but little from that which I have brought out for a wheel 4 feet diameter adapted to a curve of half a mile radius.

Hence it is apparent by what a trifling quantity the rim is required to be bevelled off, to enable the wheels to go round any curve.

Centrifugal Force and Raising of the Exterior Rail.

When a train is going round a curve at a great velocity, it is not merely the preventing of the slipping of the wheels which is to be considered the centrifugal tendency of the train, to resist the constrained motion in a curve, is not to be disregarded.

It is one of the most obvious of the laws of motion, that everybody persists in its state of rest or of motion, without

any disposition within itself to change the quantity or direction of it. As a train therefore describes a curve, its natural tendency is to move in a right line, and the effort it every moment makes to preserve this is counteracted by the reaction of the rails against the pressure of the wheels, or by some contrivance to prevent it. The swifter the motion and the more curved the line, the greater the centrifugal force or resistance of the train to the constraint imposed upon it. In the same curve therefore this is a very variable force, depending chiefly on the velocity. The method that has been proposed to meet it is by raising the outer rail, which would give a tendency to the train to slide inwards towards the centre. A slight elevation of the exterior wheel is already given in a curve by the conical form of the tire, which causes it to be raised above the inner by the difference in the semi-diameters of the parts of the wheel at the time in contact with the rails. But this is a very small quantity, as appears by the foregoing calculation; and we may say it is merely enough to mention, without being of moment sufficient perhaps to form an element of computation.

There is another circumstance which appears to me to be of much more importance, and which, as far as I can find, has been altogether overlooked in this inquiry. I allude to the opposition that would be presented to a centrifugal motion by the resistance of the wheels to slip on the rails. Generally, theorems have been investigated on the principle of preventing all tendency to slide; that is, the outer rail has been raised just so much as would be needful to prevent the wheels sliding outwards, supposing they were running on a frictionless surface. Now, the very bite, or slipping friction itself, which amounts to about one-tenth of the insistent weight, would alone compensate for a very considerable centrifugal force, and therefore render unnecessary any elevation of the outer rail. But as there would be a heavy pressure of the axles against the collars, which would add to the friction of the train, it would certainly be advisable to provide against it much as possible, which may be done by the outer rail being raised something less, perhaps, than science gives for the greatest velocity.

We shall now investigate the mathematical rules for this subject, which we believe will be found to accord with the results of experience.

Supposing the same letters to signify the same things as before, and let x be the vertical angle the plane of the rails makes with the horizon, and V be the velocity of the train in

feet per second. Then if x be the versed sine of the arc described in a second, $V^2 = x\ (2\,r + 2\,b + x) = 2\,x\ (r+b)$ very nearly. But, by the well-known principles of dynamics, $2x$ is the centrifugal force under such circumstances, which, reduced to the plane of the rails, will be $2x\ cos.\ z$. Again, if $g = 32$ denote the force of gravity perpendicular to the horizon, $g\ sin.\ z$ will be its force in the plane of the rails in opposition to the centrifugal tendency. Therefore that there may be no tendency in the train either way, $g\ sin.\ z$ must be equal to $2x\ cos.\ z = \dfrac{V^2\ cos.\ z,}{r+b}$ or

$$g\ tan\ z = \frac{V^2}{r+b}$$

But whenever the angle is small the tangent is very nearly equal to the sine; and hence tan. $z = \frac{y}{2b}$, y being the elevation of the rail. Consequently,

$$y = \frac{2\ V^2\ b}{g\ (r+b)} = \frac{11^2\ v^2\ b}{30^2\ (r+b)}\ \text{feet} = \frac{1{\cdot}61\ v^2\ b}{r+b}\ \text{inches}\quad (12)$$

where v is the velocity in miles per hour, the other measures being in feet, and the last result in inches.

In all cases the values here given will be a little too high, owing to the tangent exceeding the sine; but in general the difference will be an insignificant quantity.

Hence the following simple

PRACTICAL RULE.—*Multiply* 1·61, *the square of the velocity in miles per hour, and half the gage or breadth between the rails together, and divide the product by the radius of the curve, so shall the quotient be the elevation of the outer rail in inches.*

For example. Suppose the radius of the curve 1000 feet, the gage 4·7 feet, and the velocity 30 miles an hour; then $1{\cdot}61 \times 900 \times 2{\cdot}35 \div 1000 = 3{\cdot}4$ inches for the elevation of the outer rail. Pambour makes it 3·3.

Engineers will not fail to perceive the great difference, as regards simplicity, in the above theorem and that given by M. Pambour. I confess I cannot imagine on what principle of science the Chevalier has mixed up in his theorems the diameter of the wheels. It seems as if he had purposely gone out of the way to create difficulties for a very simple subject.

I alluded above to the friction of the train as being sufficient to bear a very great velocity in curves without any elevation of the rails. The preceding investigation will

enable us easily to calculate this. For since $g = 32$ ft. represents the force of gravity, and the slipping friction which keeps the wheels steady on the rails is 1-10th of the weight, the velocity in the curve giving a centrifugal force, just enough to balance this, must have $2x = \frac{32}{10} = 3 \cdot 2$, and therefore will be determined by the equation $V^2 = 3 \cdot 2\,(r+b)$. If therefore $r+b=1000$, we shall have $V=56 \cdot 57$ feet per second, or 38·57 miles per hour. That is, in a curve of only 1000 feet radius the bite of the wheels alone would be competent to meet all velocities under 38½ miles an hour without any elevation whatever of the rail. This is independent of the natural tendency of the carriage to slide towards the centre of the curve, arising from the elevation of the external wheel from its running on a larger diameter.

May not this property, which seems to have been greatly if not entirely overlooked, be one great reason why, amidst their high velocities and curves, the flanges of the wheels on the Liverpool and Manchester line, (for I am informed their rails are not elevated,) scarcely ever come in contact with the rails? If so, it really does away with a great deal of that fiddling nicety now too often displayed about the exact quantity of raising and adjusting the outer rail. I do not mean to contend for excluding such a mode of compensation, because I am decidedly of opinion it is serviceable in a case which seems to have been left out of consideration, namely, the reduction of the friction of the axles and collars, —I merely mean to show the uselessness of calculating and adjusting to that great accuracy the quantity of elevation.

I need hardly remark that the compensating elevation of the rail, being as the square of the velocity, it should be fitted in each case to the greatest velocity expected. When a less velocity is used, it is plain there will be a disposition in the train to slide towards the centre of the curve, thereby causing that friction between the collars and axles we have been so anxious to avoid; but this is what we cannot help.

Power of the Centrifrugal Force in curvilinear Motion to overturn a Carriage.

If a line whose length let be a, be drawn from the centre of gravity of a carriage to the line connecting the bearing of two side wheels on the rail, and a perpendicular be also from the same centre of gravity let fall on a horizontal line issuing from the aforesaid point (the angle of which with the first

connecting line call x,) the power of gravity to keep the carriage on its wheels will be as $g\ cos.\ x = 32\ a\ cos.\ x$, and the power of the centrifugal force to overset it will be as $2x\ sin\ x$. When these two quantities are equal the carriage will evidently be in such a state that the slightest force will overthrow it; and then $2\,x\ tan.\ x = 32$. But if p be the perpendicular from the centre of gravity on the same gage b of the rails, $tan.\ x = \frac{p}{b}$ and $32 = 2x\ \frac{p}{b} = \frac{V^2\ p}{b\ (r + b)}$ by our previous inquiries. Whence

$$V = 4\sqrt{2\,b\,\frac{r + b}{p}} \;\ldots\ldots (13)$$

is an equation which gives the limit of safe velocity in feet per second. To make it miles per hour put for 4 the numeral sufficient $\frac{30.}{11}$

From this equation it appears, other things being alike, that the limiting velocity is as the square root of the radius of curvature; so that the radius of curvature diminishes much faster than the limiting velocity. For instance, if the curve of a mile radius could be traversed with any velocity, say 200 miles per hour, a curve of $\frac{1}{4}$ mile radius could be as safely traversed with a velocity of half the amount, or 100 miles an hour. Small curves therefore do not increase the danger in proportion to the diminution of their radius, but in a much less proportion. And if the breadth or gage of the rails was increased in the ratio of the diminution of the radius, or if the centre of gravity was lowered in that proportion, the same velocity may be maintained with an equal modicum of safety on the curve of less as on that of a larger radius.

But our theorem gives us something more than proportions; it furnishes us with the exact quantity of safe velocity. For example, suppose the radius of curvature $= 1000$ feet, and that the height of the centre of gravity of the entire mass of carriage, wheels, &c. is just half the gage, in which case $b=p$; then $V = \frac{30}{11} \times 44{\cdot}72 = 122$ miles per hour, a velocity within which the curve of 1000 feet radius may be safely traversed.

It would appear from this, that there is vastly less danger from curves of small radius than has been generally supposed, as far as oversetting is concerned. Indeed the views that have been taken by us all have been exceedingly vague, and

our inferences consequently not so accurate as they would have been, had we founded them on proper investigations. However this must be admitted, that curves, if not so dangerous as have been supposed, are always objectionable; and that in spite of all our contrivances there must be a twisting, straining, and wear and tear, which straight lines if well constructed are in a great measure free from.

EDITOR.

ON PROPELLING RAILWAY VEHICLES BY THE WIND.

To the Editor of the Railway Magazine.

SIR,

PERCEIVING that the practicability of propelling railroad vehicles by wind has been proved by an experiment on the Durham and Sunderland Railways (see your No. for October, page 334), and having suggested the subject in your Magazine for May, page 101, I am induced to request the parties to that experiment, to communicate the details for insertion in your excellent periodical, specifying the weight of the waggons, direction, and force of the wind, description of sail used, and level, or inclination of the railway, with such other observations as may have been deduced on the occasion.

I think if the subject were fairly gone into, much interesting and valuable information would be elicited, and the question may occur how far the form of our railway carriages may be varied, so as to present the least resistance to the air, and still retain their present accommodation for passengers, &c., certes, beauty of appearance is not the character of the present vehicles, and it must be admitted there is great room for improvement in their construction, combining utility with elegance.

Trusting the subject may be taken up by abler hands,

I am, Mr. Editor, your humble Servant,

TYRO.

N. B. The information given in your Notices respecting the Grand Junction Railway relative to the Weaver Viaduct, should have appeared in the No. for September, as when your last number issued, seventeen arches of that

splendid structure were turned: it has become quite the "Lion of the North," having been visited by some thousands during the summer.

With regard to the rails, it is well known that many miles are already laid.

AEROSTATION.

By Zero.

To the Editor of the Railway Magazine.

Sir,

Ballooning is now a very fashionable amusement, and I, for one, regret such grand and expensive experiments in locomotion are made with an almost total disregard of useful results respecting our knowledge of the atmosphere. Surely it would not be out of place in your valuable Magazine to record the various experiments of this nature, when any fact is well ascertained, if only the space travelled over and the time occupied. If the course of the balloon were well described it would give us a better knowledge of atmospherical currents. But it is really a shame for a man of understanding in the present day to ascend with a balloon without taking with him proper instruments for making philosophical observations.

On the 7th October, 1836, Mr. Graham alone ascended from Cirencester, with a balloon, 35½ft. in horizontal diameter, in the shape of a pear, containing about 14,000 cubic feet of gas, and descended at Dowdeswell, near Cheltenham, 11 miles distant, in 21 minutes. Having gone in different directions, he considers the whole length of his course on that occasion as nearly 20 miles. The day was exceedingly wet.

Zero.

[We quite agree with our Correspondent as to the puerile nonsense of ascending the atmosphere for mere mountebank purposes when it may be turned to much more important. If a good barometer, thermometer, &c. were taken up, and accurately observed at stated intervals, say every 3 or 5 minutes, while a couple of good observers, with theodolites, at distant points, were simultaneously, and at the same intervals to observe the angular position of the balloon, its course, height, &c., might be accurately determined, and

two, at least, great problems respecting the decreasing pressure and temperature of the atmosphere be solved.—Editor.

On the Improbability of being able to guide a Balloon through the Air.

The preceding was written and set up in type for our last number, but was obliged to be taken out for want of room. Since then the aerial journey of Mr. Green and friends from London to Weilburgh near Frankfort having interested public attention, our opinion has been repeatedly asked as to the probability of one day navigating the atmosphere. We have ever held but one opinion on the subject, namely, that it never can be done. A balloon may possibly be made so impermeable to the gas, that it may remain up for days and weeks and even months, but this would not at all alter the case. The difficulty does not lie in keeping the balloon afloat or in raising or lowering it to any reasonable height. It lies in the management of it, the power of propelling it in opposition to the atmosphere. If we only consider the enormous bulk of the balloon and the consequent force of the atmosphere upon it, we shall at once perceive the obstacles that lie in the way of navigation. Mr. Green's when inflated, car and all, is said to be 80 feet high. The breadth we do not remember, but suppose the balloon presented a resisting surface of only 60 feet high and 20 feet wide, or 1200 square feet; at 10 miles an hour, by our table p. 95, the atmosphere would act on this with a force of about 456lbs. or 4 cwt. At 20 miles an hour the atmospheric force would be four times as much, that is 1824 lbs. or 16 cwt.

Now in the upper regions of the air it is rare that the currents are not above 10 miles an hour; they are frequently 40, 50, 70, or more. In an atmosphere therefore moving only ten miles an hour in opposition to us, we must find a means of exerting an incessant force of 16 cwt. on the air, to propel us at the rate of 10 miles an hour. How is this to be done? In the flying of birds when the wings beat the air vertically downwards, the ends of the feathers turn obliquely upwards, by which means the reaction of the atmosphere being perpendicular to the plane of the wing, gives a directive force towards the course of the bird, but tending upwards. As the wings are drawn upwards they are contracted, and the feathers yielding in the con-

trary direction, the reaction of the atmosphere still creates a directive force, but more feeble and inclining downwards. It is by these two actions combined with the gravitation of the bird that its horizontal motion is effected. Was such a principle as this attempted to be applied to the balloon, with any thing like force enough to contend with the resistance its vast bulk would experience from the atmosphere, the power must be so great as far to surpass that of the buoyancy of the balloon itself, which would consequently become worse than useless, for it would be a great inconvenience. In short we could fly much easier without the balloon than with it.

Nothing, therefore, in the principle of wings acting vertically like those of birds could ever usefully be applied to a balloon.

But suppose wings were applied to beat the air in a horizontal direction, there must evidently be a series of them. If there was a pair only, the balloon, in all cases constantly opposing their effect, would produce most unpleasant and dangerous oscillations from the direct to the back strokes. In the direct stroke the car would be thrown before the balloon, in the back stroke behind it.

Were more than one pair of wings applied, they must obviously act alternately, and those acting directly would have not only to overcome the resistance of the atmosphere to the vast bulk of the balloon, car, &c., but the resistance to the back stroke of the other wings, which, it will be recollected, are then going against the air with a velocity much greater than the progressive velocity of the balloon through it.

Besides it will likewise be borne in mind that the wings simultaneously giving the same stroke must expose a much larger surface to the atmosphere, at least perhaps triple, if they are to be effective, than the balloon; and to be able to go against any thing of a wind, their mean velocity should not be less perhaps than 100 miles an hour. By what mechanism 2,400 or 3,600 square feet of wings are to be whirled with such a vast velocity and a force of 16 cwt. or more, we confess we cannot conceive.

Probably it may be replied, that the balloon need not expose so immense a surface to the opposing air, that it might be made of an elongated form like the "Aerial Ship," which it seems ultimately sailed into the harbour of John Doe and Richard Roe. This would doubtless be a better form, but by any such figure the difficulties would only be lessened,

and in a small degree; to insure success they ought to be nearly annihilated.

Some have thought of applying wheels, like the paddle-wheels of a steam-vessel, the paddles of which should present a broad surface in one part of their revolution, when they are wanted to act, and an edge in the other part of their revolution. Others again have suggested a machine to imitate the sinuous motions of fishes, so as to scull the balloon through the air. But surely these gentlemen do not consider the difference between the two mediums, or they would not talk thus. To produce any effect by a machine of this kind, its size must be such that the whale would sink into a sprat by the side of it: and how, if it could be done, is such bulky machinery to be carried and managed? Before ever a balloon can be guided with any decent velocity through the atmosphere, two enemies must be effectually overcome—the great size of the balloon, and the excessive activity of the atmosphere, which laughs to scorn our lagging machinery. Until the former can be reduced nearer to the size of a nutshell, and the latter can be taught to present us with a face we can slap, the guiding of a balloon will, like perpetual motion, be a phantom to the wise, and an *ignis fatuus* to the weak.—Editor.

GREAT WESTERN RAILWAY.

CAPITAL 2,500,000*l.*

DATE OF THE ROYAL ASSENT, AUGUST 31, 1835.

[We have received the following account of the Great Western Railway, the state and progress of its works, &c. from a gentleman whose means of information are extensive, and on whose accuracy we can place implicit confidence. We therefore with pleasure present it to our readers, as the best and most interesting piece of information respecting the details and present state of that great work which perhaps can be given.—Ed.]

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1. *Direction of the Line and places approached by it.*

Commencing near the western extremity of Oxford-street, London, the line passes by Acton, Ealing, Hanwell, (cross-

ing the Brent by a viaduct) to Southall, (through the cattle market,) within 2½ miles of Uxbridge, (to which place a branch is projected, as well as to Colnbrook, Staines, and Egham,) through Slough, and within 1½ mile of Eton and Windsor, through Salt Hill and Maidenhead, within 5 miles of Marlow, of Henley, and of Wokingham, to *Reading*, a distance of 34½ miles, where the communication would be effected with Newbury, Marlborough, and the whole of the south of Berkshire.

From Reading the line takes rather a northerly direction, passing within 3 miles of Wallingford, and through Dudcot, where it will be met by a branch railway of 4½ miles to Abingdon, and 9½ to Oxford. The main line then proceeds westward, within 2 miles of Wantage, 3½ miles of Faringdon, 4 of Highworth, and 1½ of Levindon, where it will be joined by the "Cheltenham and Great Western Union Railway," connecting together Cirencester, Stroud, Cheltenham, and Gloucester; the latter place being the intermediate point for railway communication between South Wales and the metropolis. From Levindon, the line, taking a southwest course, passes within ½ a mile of Wotton Basset, 6 miles of Malmsbury, and 6 of Calne, through Chippenham, with branches to Melksham and Devizes, Bradford and Trowbridge, through Bath to Bristol, terminating at the depôt, in Temple-meads, a large area of nearly 20 acres adjoining the floating harbour.

There will also be depôts at Bath, Levindon, Reading, and some other places along the line. That at Bath consists of 4¼ acres, the company having power to take as much more if necessary.

At Bath a branch is already projected, from the coal fields of Somersetshire, and at Bristol the line is met by the "*Coal-pit Heath Railway*," which will bring the coal of the Gloucestershire collieries — a constantly increasing traffic—direct to the Great Western Railway.

The communication westward and south from Bristol will be continued by the "*Bristol and Exeter Railway*" (for which two extensive contracts are already taken,) to the numerous rising watering-places on the Severn, and through Bridgwater, Taunton, Wellington, and Tiverton, to Exeter; from whence, Exmouth, Dawlish, Teignmouth, Torquay, and other places of resort in the south of Devon, are easily accessible. The surveys are also made, and an Act will be applied for in the ensuing session, for a continuation of the Exeter Railway to Plymouth.

2. *Gradients and Curves.*

Considerable improvements have been effected in laying out the line since the Act of Incorporation was obtained; all tending to the acquisition of the most perfect levels, and the most economical application of steam power. For this purpose, Mr. Brunel, the engineer, has determined to concentrate a great part of the rise within a comparatively short space, by means of two inclined planes, upon which, assistant power can be employed, if necessary, and the remainder of the line, thus left free, to be worked by engines of less weight and expense than would otherwise be practicable.

There is but one summit level,* which is at about 76 miles from the London road, and consequently only about 18 miles from the centre of the whole line. This summit is 253 feet above the London depôt, and 275 feet above the Bristol depôt. From London to the summit the line rises gradually to Maidenhead, Reading, and the point of junction with the Oxford branch, by very easy gradients, nowhere exceeding 4 feet per mile, or 1 in 1320, and generally *under this*. This is a distance of 52 miles, and the part upon which the greatest traffic may be expected.

From this point, to the summit level at Levindon, the line continues to rise gradually, without undulations, and with a *maximum* inclination of 6 feet per mile, or 1 in 880. At Swindon, the line to Stroud, Gloucester, and Cheltenham, branches off.

From the summit level to Bath the line descends by two inclined planes at Wotton Basset, and at Box. The intermediate gradients nowhere exceed 6 feet per mile (1 in 880). The inclined planes are both perfectly straight, and the inclination 1 in 106, or 50 feet per mile.† The length of the first is 1 mile 30 chains; of the second, 2 miles 40 chains. Upon the latter occurs the Box tunnel, which is the only (but an unavoidable) disadvantageous feature upon the line.

* Some small intermediate undulations occur, but so trifling in extent as hardly to be perceptible in a section on the Parliamentary scale, and in no way affecting the correctness of the above as a general view of the line.

† "The descent of 1 in 107 is considerably less than the descent from the houses at the corner of Parliament-street to the Parliament Houses; it is about half as steep as Burlington Arcade, and exactly the same as the Lowther Arcade; and therefore, as regards any appearance of steep descent, there can be none."—Mr. Brunel's "Evidence before the House of Lords," June, 1835, p. 93.

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410 From Bath to Bristol the descent is one continued gradient of 4 feet per mile, or 1 in 1320. Thus, upon the whole line, there will be

	miles.	furlongs.
Level, or not exceeding 4 feet per mile .	63	4
Above 4, and not exceeding 6 feet per mile	50	1
Inclined planes	3	7
Total	117	4

and whilst the whole line (with the exception of the inclines) may practically be considered *level*, it happens that 4-5ths of the traffic will be carried upon that part of it where the *maximum* gradient does not exceed 4 feet per mile.*

The *curves* are in general very slight, chiefly of 4, 5, or 6 miles radius. Mr. Brunel considers that even a mile radius is not desirable except at the entrance to a depôt, where the speed of the engines is always greatly slackened. And, except in these instances, the only deviation from his rule which he has admitted, is in the curve, about a quarter of a mile below one of the inclines, where the radius is ¾ of a mile, and not on a level, and entirely in deep cutting.

3. *Excavations, &c.*

The total amount of cuttings between Bristol and London (including the branches to Bradford and Trowbridge, and the excavations for the tunnels,) was stated, in the evidence before Parliament, at 9,750,156 cubic yards; but this amount will be rather increased (though not in any considerable degree) by the improvements effected in the levels, and by the substitution of open cuttings for tunnels in one or two places.†

* In his evidence before the House of Lords, Mr. G. Stevenson stated that "he knew of no railroad of such an extent with such advantageous levels."—"Evidence on Great Western Railway Bill," p. 276.

Mr. Locke and Mr. Robert Stevenson gave testimony to the same effect:—"The lower the maximum can be kept upon a railway the better, because the power of the engines, or, in other words, the load that the same engines can draw, will be governed by the inclinations over which they have to take that load at any one part of the line." This is the principle on which Mr. Brunel has laid down the Great Western Line.—Ib. p. 92.

† The proportionate quantity of cutting upon the Great Western Line, and other railways, shows that the Great Western passes over an easy country. The London and Southampton Railway, up to Basingstoke, and their (once proposed) line on to Bristol, averages about 200,000 yards a mile; the London and Birmingham averages 110,000; the Liverpool and Manchester 100,000; and the Great Western 78 or 80,000.—See "Evidence before the House of Lords on the Great Western Railway Bill," p. 144.

The deep cuttings and embankments are all of moderate extent, and balance each other with sufficient exactness. The general run of the deep cutting is from 30 to 40 feet, and the embankments 25 to 30 feet. There are points where it is higher, but those are not frequent,—and only for a very short space, dropping off rapidly "down to nothing."

According to the Parliamentary plans there would be seven tunnels upon the line, amounting together to 4 miles 54 chains, but one of the longest of these has been dispensed with, and it is expected that an arrangement will be effected to substitute open cutting for another of them, which was only proposed to avoid injuring an ornamental property. If this change is effected, there will be no tunnel (except that at Box,) between London and Bath. This (at Box) is the longest tunnel upon the line, being nearly 1¾ mile, but the time occupied in passing through it will not exceed 6 minutes at the slowest rate of the engines. Between Bath and Bristol there are four tunnels; one of 528 yards, one of 1012, one of 132 yards, and one of 435 yards. The three last have the drift already carried completely through, and are proceeding with rapidity. All the tunnels will have a roadway of 30 feet wide, and be from 25 to 30 feet in height. Two of them might altogether have been dispensed with, had not the wish to avoid injury to private residences interfered.*

4. *Commencement and Progress of the Works.*

The Act received the Royal assent on the last day of August, 1835. The letting of the contracts for works commenced on the 26th of November following, and since that period contracts have been entered into on satisfactory terms, as compared with the engineer's estimates, for nearly 40 miles of the line, to the amount of upwards of 650,000*l.* The works are now in active progress between London and Reading, Bath and Bristol, and at the Box tunnel, and the line is marked out, and the preliminary steps for preparing

* The Great Western Line is about 6 miles longer that the London and Birmingham Line, and it will have about ¾ mile less tunnelling in the whole. The longest tunnel on the Birmingham Line is 1¼ mile; and on the Liverpool and Manchester Line there are now two long tunnels; the first, 1¼ mile in length, having an inclination of 1 in 48, through which all the goods pass; the second, also 1¼ mile long, 18 feet high, and 25 feet wide, with an inclination of about 1 in 100, to carry passengers into the centre of the town.

the contracts of the principal works in the intermediate portion are completed.

It is expected that the line will be completed from London to Maidenhead in the Autumn of 1837, from Bristol to Bath in the Spring of 1838, from Maidenhead to Reading and to Oxford by the Autumn of 1838, to the Cheltenham branch in the Spring of 1839, and the whole completed within four years of the commencement.

The satisfactory execution and completion of all the contracts in their different stages, within the respective times allotted to each, is secured by periodical penalties.

5. *General Dimensions.*

Length		117½ miles.
Breadth of way on embankments and viaducts, and under bridges . . .		30 feet.
Viz. for double line of railway guage, or width of each 7 feet .	14	
Space between the two lines .	6	
Space outside ditto, 5 feet each .	10	
	——	30 feet.
Breadth in cuttings (additional space for drainage)		36 to 40 feet.
Cuttings—general run of the deep cuttings		30 to 40 feet.
Embankments do. do. of highest		25 to 30 feet.
Tunnels—breadth of way . .		30 feet.
Height to crown of arch .		30 feet.

Planes—greatest inclination 1 in 106, or 50 feet per mile.

	miles	fur.
Total length of planes, with an inclination exceeding 6 feet per mile . . .	3	7
Sum of level planes, or not exceeding 1 in 880 (6 feet per mile) .	113	5
Total length	117	4

6. *Estimates.*

Cost (as proved before Parliament).

For making the railway (at full prices for labour and materials) . . .	£1,856,820
For land and compensation (including depôts)	337,000
For engines, carriages, and *contingencies* .	306,180
	£2,500,000

Traffic.

Annual passengers, 522,184, (persons now travelling various distances on the line, exclusive of short journeys within 15 miles of London,) at 2d. per head per mile	£418,764 13 4
Merchandize, cattle, and parcels . .	265,823 14 4
	684,587 17 8
Deduct expenses (on scale of Liverpool and Manchester Railway) .	337,579 6 8
Net revenue	£347,008 11 0

Or, 13*l.* 17s. per cent upon a capital of 2,500,000*l.*

7. *Table of Distances, Gradients, and Levels.*

	Distance from London Depôt.	Distance from Bristol Depôt.	Intermediate distances.	Level above London Depôt.	Greatest inclination in the intermediate distance.
	Miles.	Miles.	Miles.	Miles.	Ft. In.
London depôt . .	...	117½			
Maidenhead do. .	23½	94	23½	42	4 0
Reading do. . . .	34½	83	11	74	4 0
Junction with Oxford branch	52	65½	17½	...	3 6
Oxford, by branch . .	62	75½	10	...	4 0
Summit level at Levindon	76¼	41¼	24¼	252	6 0
Chippenham	93	24¼	16¾	...	6 0*
Bath	106	11½	13	15	6 0*
Bristol	117½	...	11½	22½ below	4 0

* Exclusive of two inclined planes.

8. *Table of Time*,

which will be occupied in travelling between London and Bristol, and the principal towns on or near to the railway, at the *minimum* velocity of 25 miles per hour.

		hrs.	min.
Slough	about	0	45
Maidenhead		1	0
Reading		1	25
Oxford, by a branch of 10 miles		2	25
without ditto		4	20
Wantage		2	30
Levindon		3	0
Gloucester, by a branch of 28 miles		4	10
Cirencester		3	30
Stroud		4	0
Wotton Bassett		3	15
Chippenham		3	45
Melksham, by a branch of 5 miles		4	0
Trowbridge, or Bradford, by a branch of 9 miles		4	15
Bath		4	10
Bristol		4	40

ON THE LAYING OUT OF LINES OF RAILWAY.

BY THE EDITOR.

[Continued from No. II., page 59.]

I WAS unfortunately prevented at the time from concluding the few remarks I had then to make on laying out lines of railways from circumstances over which I had no control, and since that time I have been unable to resume the train of thought I was then in, and consequently most of my remaining views have been lost, some of which appeared to me to be important. However, as it is necessary to conclude the subject in the present volume, I shall here add a few remarks; and should I ever recollect what I have at present lost sight of, I will throw them together in the form of an appendix.

10. *Railways in the immediate neighbourhood of large towns should always be carried on an embankment or viaduct, or if necessitated to go into cutting, they should be well protected with lofty walls.*

This is a matter of such obvious necessity as scarcely to

require an observation. If near a large town a line of railway was left exposed, where would be the possibility of preventing accidents? It matters but little whether it was left without fence or exposed in a cutting so that the idle and mischievous might be able to throw sticks or stones down on it. As to keeping them off, it would be akin to impossibility: and a stick or stone thrown on the rails by some idle fellow might upset a train or turn it off, and produce the most disastrous accidents. Prudence would tell us, wherever it is possible, to carry it along a lofty embankment or viaduct. Such a method would afford the greatest safety to the train, and most convenience for crossing it by the inhabitants. But if this cannot be, it is indispensable to guard it well with high walls.

11. *In long lines it seems better to concentrate the gradients in one or two places than to have a series of undulations or planes up and down which full steam cannot be applied.*

Great diversity of opinion exists on this subject. Our reasons are simple and few. No line works so economically and well as a perfectly level line; that, therefore, which approaches the nearest to it must obviously be better than one which approaches less. A line which is perfectly level can carry a greater load with the same expense than any other. For though it be true, as I have before shown, p. 206, that a line up and down whose inclines full steam can be applied, can be traversed in precisely the same time, setting aside the resistance of the atmosphere, as one in which the inclination is either nothing or uniform throughout, yet the inclines, generally speaking, must severally be sharper than than that of a uniform plane. Therefore, and because it is the most difficult plane on the line that determines the load which can be carried throughout, the undulating line must evidently be less powerful than the non-undulating.

Again, with the same load the undulating line in actual practice could not be traversed in the same time. For the resistance of the atmosphere varying in the duplicate ratio of the velocity, is much more increased in the descent than it is diminished in the ascent. Nor does the shorter time in which it acts in descents make up for the great excess of its action in them. In fact the total time of transit appears not only to be greater, but the mean strain, and consequently the wear and tear, greater in an undulating line than in one that does not undulate.

If this then is true for a given length up and down easy

planes, in which full steam can be applied, how much more so is it if the inclines exceed those, and where in every descent the power of the engine is wasted, and the steam sent off to buffet the atmosphere without any useful return?

In traversing an undulating line there are two distinct species of loss—the loss of load in ascending planes so much steeper than are needed, and the waste of power in descending such planes as are too steep for the application of full steam. What the descents are which admit of full steam is a matter which is not exactly agreed on. It must depend on considerations of safety and of the load to be carried. Full steam may evidently be used with heavy loads down much steeper inclines than it can with light. For example, suppose we have a load which the engine will take along 30 miles an hour on a level, and let it be considered unsafe to go down any plane quicker than 40 miles an hour, this would correspond to a fall of 4·7 feet per mile by our table *p.* 95. Now, if the load was doubled the velocity in every case would be halved, and the 40 miles an hour would require a plane falling between 11 and 12 feet per mile; that is, a double load could travel with as much safety down descents of 11 ft. a mile as the other down those of only 4·7 ft. Some may imagine that to be equally safe a heavier load should go with a less velocity. This, however, is not the case. The danger is not supposed to arise from the breakings of the carriages or of the rails—for if they are not made of two or three times the strength they are wanted they ought not to be used—but from the trains running off the rails. In this respect heavy loads, by keeping the trains tighter on the rails, are manifestly much less likely to be thrown off than light, and therefore would retain equal safety at higher speeds.

As far as regards the actual expenditure of power, it does not appear that there is any difference if full steam can be used all the way, and the atmosphere be disregarded, whether the line undulates, or is level for a certain extent, and then all the ascents united into one steep plane. In each case the expenditure of power is the same. But the advantage of concentration is, that all the great efforts, instead of being scattered over a vast extent of ground, are brought to bear upon one point, for which provision is always made. Besides it is much better and more comfortable for the passengers to have a change of velocity for a short distance, and then to prosecute their journey by one steady uniform pace, than to be creeping along sometimes 4, 5, or 6 miles an hour, and at others shaking their nerves with the terrific

velocity of 50 or 60 miles an hour. Little as this may have been regarded, it is a matter for graver consideration than it at first sight appears. Passengers are by far the most lucrative for railways. They will not be jostled and knocked about any how: nor will they be alarmed and inconvenienced with impunity. They are a sort of goods that must be kindly and tenderly treated; their prejudices must be attended to and their wishes gratified, or they will not long continue on the profit side of the account.

Whether there would be a saving of expense in the concentration of the inclinations, is a point about which there is some doubt. If a single engine could take the load the whole way, the expense might possibly be even less on a line moderately undulating than if all the inclinations were united and assistant power required. But if assistant power is to be used at several points distant from each other, there can be do doubt whatever but it would be more economical to bring all the assistant power to work in one place; for there would then be but one auxiliary engine and one set of auxiliary men, and the preparatory expenses of getting the assistant engine ready, would be in the singular number, not in the plural.

It must here be distinctly borne in mind, that in concentrating the planes we must keep the same summit level. If for the sake of having a good line for a number of miles, we ascend to a much higher summit, we shall in all probability pay too dearly for it. Nothing in my opinion but the avoiding of a very bad country would justify such a step.

12. *In crossing navigable rivers, roads, &c. it is better to use impetus and sharp rises, than to make swivel bridges or long and expensive embankments.*

Engineers, when long tracts of fens and marshes have come in their way, have almost ever avoided them in consequence of the supposed expense of continued embankments to cross the rivers commonly intersecting them. If, however, there is room for getting up a velocity, it is generally practicable to pass them by the force of impetus alone. For if we can get up a velocity of 25 miles an hour, and the engine continues barely to overcome the friction on a level, a perpendicular elevation of less than 21 feet may be overcome by the impetus only; and if the required velocity was 30, 35, and 40 miles an hour, perpendicular ascents respectively less then 30, 41, and 53·5 feet may, by our so often cited table at p. 95, be surmounted. And because it is the perpendicular elevations only that are regarded, the rises

over the bridges may be as brief as we please within reason. Long embankments therefore are by no means essential. It is only needful that the ascents be not so steep as to cause a shock. If this principle was judiciously acted on, there would scarcely be an instance where a swivel bridge would be necessary.

Some have imagined that elevations may be surmounted by alternate levels, and what are termed jumps or sudden rises of a few feet, up which the trains are to ascend by the force of the impetus. I have looked at this view with some attention, and I confess I can see no advantage whatever to be expected. On the contrary, I apprehend a great disadvantage. For the great loss of velocity in ascending the jump—11 miles per hour for 4 feet of perpendicular ascent—would occasion such a consumption of time to recover, such a straining of the engine, and consequently would require one of so much more power to get up this deficiency rapidly than would be needed for maintaining a uniform velocity, that I conceive would be seriously prejudicial.—Ed.

REPLY TO C.'s REMARKS ON THE HABITUDES OF IRON AND STEEL.

By William Maugham, Esq.

To the Editor of the Railway Magazine.

Sir,

Agreeably to the promise I have so often made, I now sit down to answer the letter of your correspondent C. which was inserted in your sixth number* in reply to a hasty communication of mine which is contained in the preceding number.†

Some of the remarks of C. are ingenious and evidently deduced from experience, but the generality of his remarks are most undoubtedly objectionable, because they are not consonant with the principles of chemistry. Whenever we neglect to make the *art* of chemistry subservient to the *science*, we then resemble the benighted traveller pursuing an unknown path with a will-o'the-wisp for his guide. In giving an explanation of the process which I briefly explained of fusing iron and then casting it under water, he

* Page 209. † Page 183.

has, in the boldest manner, advanced theories which, if correct, would shake the present state of chemistry to its very foundation. I shall, in the first place, refer you to what he has advanced in respect to the several states of iron, and to his explanation of the process of *puddling*, &c., at page 210, and shall next observe that the difference between *cast iron*, *forged iron*, and *steel*, is evidently owing to the absence or presence of two elements, namely, *oxygen* and *carbon;* both of which are present in cast iron, but in forged iron they do not exist except in comparatively very trifling proportions; whilst in steel, carbon, but not oxygen, enters into combination with iron. In the operation of *puddling*, at the elevated temperature to which the metal is exposed, the oxygen in the cast iron combines with the carbon which the iron had acquired in the casting furnace, and they both pass off in the state of carbonic acid gas; but your correspondent C. very ingeniously gets rid of the carbon, by giving it a *gaseous* form!! *Gaseous carbon* is hypothetical; it is what C. would call one of the *idola tribûs*; the term, however, has been conveniently introduced in science for explaining the composition of certain compounds of carbon with other bodies by volume, but gaseous carbon does not apply to C.'s case.

C.'s theory of the cause of the explosions which he conceives would take place during the process of casting iron in the manner I proposed is founded in error. He states that similar explosions take place in the ordinary manner of making castings, and that they are owing to the decomposition of water contained in the sand of which the mould is constructed, by which means there is, as there would be in the case in point, "*a formation of a quantity of inflammable gas within the mould—hydrogen, no doubt, mixed with a portion of oxygen.*"!! For the sake of argument I will admit all this. I will admit that the heated iron may take oxygen from the water, and that the hydrogen of the water will consequently be liberated in the state of gas; but where does C. meet with oxygen gas, or with any other gas, that will form an explosive mixture with hydrogen, for hydrogen gas of itself is not explosive? There is no doubt that, whenever an explosion takes place whilst casting iron in the usual manner, it is owing to the water in the mould being converted into steam by the hot metal; this steam accumulating under pressure, its explosive effects may readily be conceived. If the latter explanation should be deemed unsatisfactory, I would ask, how it occurs that explosions take

place during the casting of those metals which have not the power of decomposing water, and from what source C. will then obtain a mixture of inflammable gases?

Another objection of C. is, that the "*intense hardness of the castings*" conducted on my principle, "*would in nineteen cases out of twenty be a most important disadvantage; and last, but not least, the plan would be an impossibility except in a very few cases where iron moulds are used, because the water would* dissolve *both the loam and sand of which the moulds for iron castings are usually composed.*" Now, as I proposed the mode of casting iron under water solely for ornamental purposes, as for busts, &c., I did not conceive the hardness which the metal acquires during the process could be at all objectionable, my object being to obtain sharper and cleaner castings than those usually afforded; and as loam and sand moulds must in such cases be entirely laid aside, there would be no fear of the loam and sand *dissolving* in the water (!) as stated by C.

Let me now call your attention to the following passage in C.'s letter:—"*The best experiments of the laboratory must never be depended on; they only afford leading points to which attention should be directed; for the element of heat is so materially altered when practically operating on a large mass to what it is when the experiment is made on a small scale, that similar results are scarcely ever obtained.*"!!! Every experiment made in the laboratory even on the smallest scale furnishes us with certain data that may be turned to the most useful account in the large way. Matter obeys the same laws both in the atom and in the mass, and nearly all the improvements that have from time to time taken place in arts and manufactures have originated from laboratory experiments. Why does he who operates on tons of matter ask the advice of him who is accustomed to draw conclusions from effects produced from the mutual action of mere particles, and why is such advice afterwards acted upon and found so eminently advantageous? The reason that precisely similar results are not always obtained on the large scale as when operating after the laboratory fashion is, because in the latter case pure materials are usually employed, which would be too expensive for the manufactory. It is well known that scarcely a single article in a state of purity is brought to market. Heat is nothing more than the result of intense chemical action, it may be modified, it may be augmented, it may be decreased, but it is only *altered* when it becomes latent, and in that state it

cannot be of service for either manufacturing or laboratory purposes.

C. has by no means settled the question whether iron and carbon combine in definite proportions or not, for his stating "*there is the greatest reason to suppose that they do not,*" and "*I think*" so and so, is a very *per saltum* and conclusive mode of arriving at—nothing.

In conclusion I have to observe, in addition to what was advanced in my former letter respecting the casting of iron under water, that the instant the heated metal has filled the mould placed under water at the requisite depth, which depth experience will point out, a stream of water should be instantly turned on in sufficient quantity, by which means the heat will be carried away and thus the water will be prevented from passing to the state of steam, and consequently no explosion can possibly take place.

I am naturally of an indolent disposition, otherwise I might notice many other particulars in C.'s letter, in which he appears to see a mass of things, but few of them distinctly. I remain, &c.

WM. MAUGHAM,
Lecturer on Chemistry, Adelaide Gallery.

Nov. 23*d*, 1836.

EXPERIMENTS WITH RED HOT IRON AND WATER.

To the Editor of the Railway Magazine.

SIR,

THE following experiment which was related to me a short time since, appears to possess some features analogous to experiments formerly adverted to in your Magazine:—

Two similar pieces of iron, each weighing between three and four ounces, were heated to a bright red heat in a common furnace; two vessels, containing about a couple of pints of water each, were then filled, the one with clean spring water, the other with water in which some soap had been dissolved, both being cold. One of the pieces of red hot iron was then placed in each vessel. The iron put into the clean water almost immediately lost its redness, evolving steam and hydrogen from the water; the other piece, which

was plunged into the water containing soap, retained its redness for several seconds, apparently unaffected by the water. After a short time it lost its luminous appearance, and gradually cooled, but without any appearance of steam or hydrogen being given off, as usually happens when hot iron is plunged into water. The temperature of the water which contained the soap was sensibly higher than the clean water after the experiment, though previously both were alike.

I have not myself repeated the experiment, but I have no doubt of its correctness; and it is not without some corroboration in the common operation of *hardening* steel. In this process, unless the water be quite clean the steel will not harden; and, from the above experiment, we may suppose this is owing to the water not acting on it with sufficient rapidity to bring the particles into the proper state of aggregation.

Perhaps some of your correspondents may be able to account for these facts.

Yours truly, H.

London, Nov. 21.

To the Editor of the Railway Magazine.

Thames Haven Railway Office,
34, Abchurch Lane.

Sir, *Nov.* 20, 1836.

By a reference to the reports of the House of Commons, you will find Mr. Thompson in error as regards the returns of the Thames Haven Company: the amount of income on the capital, 450,000*l.*, is 109,790*l.* 9s. 7d., or about 24 per cent., and not 18 per cent., as stated by him, and also in Mr. Robertson's Comparative Railway Table.

I am, Sir, &c.,
Edward West.

[We cannot imagine how this difference can exist between gentlemen who draw their information from the same sources. We shall be glad to see the cause of the difference explained. —Editor.]

KENT RAILWAYS.

By Taffy.

To the Editor of the Railway Magazine.

Aberystwith, Nov. 19, 1836.

Sir,

I beg leave to thank you for the ready insertion which you gave to my letter of the 22d ult., more especially as its publication had become in some measure unnecessary by the previous withdrawal of the offensive assertions against which it was directed. I congratulate the promoters of the London, Romford, Rochester, and Chatham Railway upon their good taste in abandoning an untenable position. With that concession ends my hostility; and if their project be one of merit I heartily wish them success, albeit I must still consider their course to be, in the phraseology of an honest sea-officer of my acquaintance, a rather "carcatuitous woyage" from London Bridge to the Medway.

It seems that, judging too hastily from appearances, I have committed an error in charging the Thames Haven Company with being a party to this novel scheme, and although I am not conceited enough to suppose that the *unfounded* statement of a Welsh mountaineer could work them much evil, they will allow me, I hope, to disburden my conscience by a prompt apology for the mistake. Nor should I omit to extend the *amende honorable* to the patrons of the Eastern Counties' Railway, from whom, in my ignorance, I had withdrawn a portion of the honour to which I now presume they are exclusively intitled; at least when those who are ambitious of presenting their *deposits* at the shrine of this young Essex idol are directed to the Eastern Counties' Office for information, it is no unreasonable conclusion that the hint indicates not only the home of its infancy, but the precise place of its birth. May it "*survive,*" with more than a "*slender chance*" of fulfilling its happy destiny, and not, like too many a hapless urchin, be swept away by the stream which it proposes to ford!

You must, I think, admit, Mr. Editor, that this, from an opponent, is a tolerably disinterested prayer; but the fact is, I can afford to be liberal, for, since I last addressed you, I have received from my London Correspondent a copy of

the new prospectus just issued by the Directors of the Kent Railway Company, a document* which abundantly justifies my late remonstrance against the fallacious assumptions which a proper regard to my own interest, and that of my brother-subscribers, prompted me to expose. If, as a Kent shareholder, I have any fault to find, it is that the *comparative* strength of our case is not fully displayed, and that from a fastidious delicacy towards projects which deserve no such consideration, the Directors have veiled the immeasureable superiority of their own. Moderation, however, even in the extreme, is far more commendable than its opposite, and to the simple straightforward statement of its Committee, the Kent Railway will probably be indebted for a degree of public confidence to which the more arrogant competitors of that enterprise will aspire in vain.

Want of time prevents me from directing your attention more particularly to one notable project lately "got up" in Kent; and besides, the *humbug* is not yet ripe for the exposure to which, if my London friend be not egregiously mistaken, it is inevitably doomed.

I remain, &c. TAFFY.

THE PNEUMATIC RAILWAY.

To the Editor of the Railway Magazine.

SIR,

IT may not be uninteresting to some of your readers, and particularly to those among them who are shareholders in the Pneumatic Railway, to be informed of the method in which that system is being carried into operation on the line of demonstration now forming at Kensington; and particularly because the method described in the following paper, and exhibited in the accompanying drawings, is a variation from the mode partly but imperfectly described in the first series of the "Railway Magazine," but embracing the same pneumatic principle, namely, the transmission of the power of a stationary first mover through the medium of a rarefied column of air contained in an extended conduit or main, laid on a line of railway, and which rarefied column is made to give back the power expended in gene-

* See it on the wrapper.—ED.

rating it, by its communication with a pneumatic locomotive engine, to which it imparts impulsion and puts in motion a train of carriages.

I propose to describe in the following paper, 1st, The varied mechanical arrangement of the combination making up the Pneumatic Railway, and its locomotive engine (except only the minor details providing for branches, crossings, &c., &c., all of which are as simple in their arrangement in this as in the common railway); 2d, The operation; 3d, To exemplify the philosophical principle which is applied to put the mechanical combination into action; 4th, To show the expense of constructing a line of railway on this system; and, 5th, To exhibit the comparative economy of it and the common system of railway, and the advantages of greater durability and safety possessed by the former.

It will be seen by a reference to the Numbers (May, June, and July, First Series) of the "Railway Magazine," that the method first proposed for carrying into effect a Pneumatic Railway was, to construct a main whose diameter afforded at the same time, a sufficient breadth or base for the wheels of the carriages to run on ledges or rails, cast or put on to the same semi-diameter of the main or tunnel, and have such an area, as to admit an expanding diaphragm of such extent of surface as to allow, with a low degree of rarefaction, an ample impelling power to propel a suitable load with the diaphragm, the latter along the interior of the tunnel. The whole column of air contained in a section of 2½ miles was abstracted in advance of the diaphragm, which was impelled through the interior of the main with a force, by the pressure of the incumbent atmosphere; equal to the degree of rarefaction maintained in advance of it. The air entering the tunnel through a continuous valve and impinging on the diaphragm. The diaphragm was carried by a car in the form of a velocipede, whose wheels were grooved and ran on a single track of rail on the interior of the main. A flat projecting arm connected this vehicle with a governor, or other vehicle, moving on the exterior of the main, and which opened and closed the continuous valve so as to allow a free passage for the impelling arm and admit the atmosphere. The enhanced cost of iron (which was the principal material to be used by that method, and which in fact was a substitute for earth-work, bridges, tunnels, and stone-block, all which involve generally the very large expenditure inevitable on the common system of railway,) induced the variation of the method herein described, by

which many important advantages accrue in the economy not only of the material to be used, but also in the capacity of the first mover and machinery, only one-eighth as much iron is necessary by this latter arrangement as was required by the former. The quantity of material now wanted, the labour in constructing it, and the method of applying it, will clearly demonstrate that on such lines as the London and Birmingham, the Great Western, the Brighton, and some other railways, only one half the expenditure of capital needed by those would be necessary in this railway, which will be equally efficient in practice, much less expensive in the maintenance, and infinitely safer in operation.

The general improvement of this varied arrangement, it will be observed, consists—

1. In diminishing the size of the main or tunnel within which the power is maintained, and along which it is transmitted, from the diameter contemplated by the former arrangement of 40 inches to the average diameter of 10 inches.

2. In substituting a pneumatic-locomotive engine, which takes up power from the main without discharging it, and is contradistinguished from the steam-locomotive by the absence of furnace, boiler, and tender, and is free from the weight and action which renders the latter a very destructive agent.

3. In affording the locomotive the means of taking up and employing power, according to the load to be drawn or the acclivity to be overcome.

4. In bringing into available action the adhesion of any or all of the wheels of a train of carriages, so as to augment the impelling power on ascending planes, and to render great weight in the locomotive engine unnecessary.

5. In the application of an improved and self-acting brake to several axles in a train, by means of which the speed of a train, moving on a descending plane, is rendered more secure and uniform; and, independent of the attention of a brakesman.

6. In an improved and economical method of constructing the permanent railway, and of attaching and supporting the rails, by means which obtain greater stability with less material.

With a view to simplify the following description, and to render it easily comprehensible to those of your readers who may not be familiar with scientific and technical terms, I shall avoid them, and proceed to describe the combination,

and such of its parts as may render familiar the description; and, to make the superstructure more easily understood, I will begin at the foundation, or railway on which the carriages move and support the load.

The common method of constructing the railway is by placing stone blocks, one foot thick, having four square feet horizontal surface, at the distance apart of three feet from centre to centre of the blocks; on those centres are fixed cast iron chairs, weighing about 12 lbs. in which are laid the wrought iron rails; these are, therefore, supported by props three feet apart, which allow the rails to deflect or bend as the wheels roll along them; this bending raises, in a slight degree, the ends of the rails which consequently receive a succession of blows from the wheels, this and the bending of the rails, and the action of the engine and train, cause a vibratory and rolling motion, which loosens the foundation, unsettles the blocks, which get into undulating lines, the opposite tracks lose their parallelism, and much wear and tear of the engine carriages and railway is the consequence. The railway bar must have sufficient strength to bear the weight and resist the concussion of the passing load without breaking under the deflection. It is desirable that the railway be permanent and have the least vibration. Railway bars were formerly made weighing 35 lbs. to the yard, they are now made 70, but the method of arranging the block and rails cannot be maintained upon any true, scientific, or mechanical principle. It is a well-known fact, that on some railways in the United States, locomotive steam-engines, copies of those constructed in England, and made by the same manufacturer, do not incur half the expence for wear and tear that similar engines used in England have. This circumstance is found, upon inquiry, to arise from the mode of constructing the permanent way with long wooden string-pieces on which the railway bars are laid, a much less vibratory action is the effect; but this, too, is found not to be economical, on account of the rapid decay of the timber; and some of the ablest engineers now recommend the adoption of stone blocks in lieu of the wood; this will, of course, bring back the expence to the account of the locomotive steam-engine, yet the great length of some of the railways in that country would appear to make this the more advantageous arrangement. My desire has been to provide such a combination of material as to produce a similar effect to that of the wooden string-pieces, and which shall not be

subject to their destructability, and without enhancing expense.

A reference to the accompanying engraved plate, (Drawing No. 1,) will show the arrangement of a series of undressed stone blocks, RR in elevation, and RR in the end view. These are 4 feet long, 10 inches thick, and 16 inches wide; their ends are squared, are placed in contact forming continuous parallel lines; these are laid on the usual macadamized foundation; at the end of every fourth block there is pile *h* 2 planted three feet deep, the piles being exactly opposite each to the other on the parallel tracks, and are united by cross ties *m* 3, *m* 3 of wrought rods; the top of the pile has a wrought iron band, *h* 3, over which is fixed a chain, *m* 1, of great strength. The parallel railway-bars, *m* 2 *m* 2, are laid on the blocks, which give to them a *continuous* bearing, the ends of the bars resting on the chairs *m* 1 *m* 1, to which they are affixed by iron wedges. In the ends of the blocks are notches, which receive wrought iron bolts, *h* 1 *h* 1, having their lower ends enlarged, and their upper ends bent over as seen at RR in the end view, the bent ends of the bolts overlap the railway bar, and admit wedges *n* 1 *n* 1; these fix the bars firmly to the blocks and suspend the ends of the blocks to the bars. We have here two desirable things, a continuous bearing for the railway bar, and maintenance of the parallelism of the permanent way; the former will consequently give greater stability with half the weight of bar and allow less vibratory action, and the latter prevent that widening of the tracks which, without constant attention to and expense of adjustment, permit the wheels of the carriages to get off the railway. We have likewise security against the settling of the blocks and their getting into undulatory lines, their ends being suspended to the bars which do not deflect and prevent their sinking, and they consequently sustain the moving load with a direct vertical pressure. The absence of flexure in the bars must obviate the concussions which are otherwise common, and which by this arrangement would, if any, be received by the piles which can better resist them.

This mode of forming the railway tracks will be still more advantageous when combined with the Pneumatic Railway, which, not having the ponderous locomotive steam-engine and tender, weighing usually 12 tons, which are the principal agents in the destruction of the permanent way, and cause an expence for wear and tear (as on the Liverpool and

Manchester line) of 500*l.* per annum per mile. The next object in order of structure is the pneumatic main or conduit of power E, of the form shown in section in the end view; this may be compared to a common gas main, laid between the tracks of a railway as between RR; it is, of course, extended along the whole line of railway, except only on the descending side of inclined planes that have declivities greater than 1 foot in 240 feet, and consequently provide an impelling power by the weight or gravity of the load whose retarding friction is about equal to such a plane. The main may be made of cast iron, such as gas mains, five-eighths of an inch thick, or of wrought iron rolled or drawn into form, one quarter of an inch thick, and stiffened by occasional rings of metal. Those that are now being used on the line at Kensington are of cast iron, made in lengths of 15 feet, the ends having sockets similar to gas mains, and they will be united and their joints made as gas mains.

The average diameter of the mains will be about 10 inches; that is to say, when the sections on a line of pneumatic railway, are formed into lengths of 5 miles each by intervening station valves, which *intersect* the mains at the stations of the fixed engines; then the diameter of the main for the first mile and a quarter may be 11 inches, and the second mile and a quarter 9 inches, that is, to the extent of two miles and a half in *one direction* from the stationary engine, and in like manner to the extent of two miles and a half in an opposite direction, from the same engine which thus operates through five miles of the main. The mains, leading in like manner two miles and a half from the adjacent station in one direction, make up a section of five miles.

On one side of the main is a trough formed by the raised sides as at E: these sides are four inches high, and the distance between them 5 inches. Through the lower side of this trough is a continuous chase, or opening into the main, forming a valve-aperture 2 inches wide, having steps on each side of the aperture one inch and a half wide. Into these steps are inserted screws, 5-8ths of an inch wide, placed one foot apart, as at E in end view, and at 5, 5, 5, 5, in plan drawing No. 2; these attach the metallic valve to the inside of the trough, which becomes a guard to the valve that is composed in the following manner:—An amalgam of iron and copper, formed into sheets 5 inches wide and 20 feet long, one-eighth of an inch thick at one edge, and one-

sixteenth of an inch thick on the other edge; the thick edge is turned up for one inch, and is screwed down to the steps as at E. The metal of the valve is planished, or hard rolled into form; this makes it stiff and gives to it a spring. The ends of the sheets composing the valve are connected at their ends by overlapping, rivetting, and soldering, the laps being in the direction of the moving train. The valve stands 4 inches high, and is nearly even with the top of the trough. The insides of the upper edges of the valve, for a depth of one inch, are polished smooth and made perfectly even. Holes are made through the lower edges to admit the screws as at E and 5, 5, 5, 5, in Drawing No. 2. In attaching the valve, the screws protrude through their lower edges, between which and the step there may be a surface of felt or leather and cement; over the turned edges of the valve are laid metal bars, half an inch thick and one inch wide, pierced with holes corresponding with screws which protrude through them, and then by means of nuts, as at E and 5 5 5 5, the whole is screwed firmly down so as to form an air-tight joint. The valve is formed into such vertical curves as that when screwed down, the upper edges forming the polished lips, are pressed together by the flexure or spring of the metal, with a pressure of less than one pound on the square inch of surface in contact, and when so fixed will always continue in the same state and form an air-tight joint, unless forcibly separated. When the valve is fixed, the trough is narrowed on the inside by planks on either side to two inches, so as to prevent the valve from opening beyond its flexure, by the passing tongue hereinafter described. The main communicates with the exhausting pumps of the fixed engines at the stations, which may be two or three hundred feet from the line of railway, by curved branch mains without valves, and which are laid under ground.

The railway so constructed is now in a state to receive the pneumatic locomotive-engine and attached train, shown in elevation at A, in end view and part section at C in drawing No. 1; and in plan at D and P, drawing No. 2. In A, C, and D, the same letters of reference apply to all the diagrams respectively.

Situate on the railway R R, and immediately over the mains E, is the locomotive, to whose wheels *a a a a*, being six feet diameter, is suspended the frame of the carriage *b b b*, by the springs *c c c*, these rest by bearing blocks on the axles *d d d*, which are fixed to the wheels and revolve with them. To the frame *b* is suspended an expansion or

vacuum vessel *e e e e*, of the form seen at C. This may be regarded as a reservoir of power imparted from the main E. On a cross frame, suspended by the frame *b b b*, are fixed the working or piston cylinder *g g g*, having ways or passages *h h*, on which are placed slides *k k*, seen at C and D. The slides are connected by rods *l l l*, that work through guides *m m*, on which are attached levers *n n*, which move the rods *l l l*, and reverse the slides *k k k*; *o o o* are guide frames, in which move the piston rods, to the ends of which are attached the guide wheels *r r r*, to these are attached connecting rods and slings *p p p*, these give motion to the crank-axle *d* 1 *d* 1, to which the slings and rods are keyed. S S S are excentrics fixed on *d* 1, and attached to rods that open and shut the slides *k k k*. These rest by a notch on cross axles *t t t*, to which they give action; *u u u* are iron cross-pieces, to which are suspended horizon friction-wheels V V V, whose axles Y Y slide in slots in the spring boxes W W, and are pressed by the spiral springs *x x*, which keep the friction-wheels in contact with the sides of the trough, and under the projecting ledges of the main E; *z z* are throttle-valves situate in the valve apertures, these establish a communication between the passages *h h h*, leading to the top and bottom of the cylinders *g g g*, with the expansion vessel *e e e*, as shown in the end view drawing No. 1. At C is a governor attached by cords and pulley to the throttle-valve, which regulates the ingress of the external atmosphere and the speed of the pistons. G, drawing 2, is a buffer acting on the spring K, *a* 3 *a* 3 are drag-chains acting on the same spring by the levers *a* 1 *a* 1. In drawings Nos. 1 and 2, *b* 1 *b* 1, as at A and B, is a passive and self-acting brake-wheel and friction-band, *b* 1 being the brake-wheel, and *b* 2 the iron band, *b* 3 is a lever which brings the friction-band in contact with the wheel, and *c* 1 is a pendulum suspended by the bent pendulum-rod to the fulcrum *c* 2, which makes it self-acting. Similar brake-wheels may be placed on any of the axles of a train as at B. This brake-wheel may be applied to any common stage-coach or carriage. P, at A C D in drawings 1 and 2, is a hollow tongue, suspended from the vacuum vessel *e e e* by an air-tight ball and socket-joint, and projecting through the lips of the valve, as seen in the end view and in plan. The top of the hollow ball, opening into the vacuum vessel *e e e*, as seen at the black mark in end view, which is broken away to show the manner of placing the ball in the socket; this hollow ball forms a communication by

the cavity in the tongue between the expansion vessel *e e e* and the main E. The lower part of this tongue entering the lips of the valve is made of hard steel, having a polished surface, its horizontal section (as at B in plan drawing 2) forming two parabolic lines, whose extremities intersect at a distance of about 40 inches, and whose transverse section is one inch in the middle of the curves, the cavity in the tongue shown by the black space at P is 36 inches long by 5-8ths of an inch wide; the exact size of the lower part of the tongue will necessarily depend on the degree of flexure of the metallic valve, consequent on its thickness and tenacity; if the lips of the valve be separated in any part for one inch, its flexure will form the curved lines above mentioned, the tongue therefore must be of the size and form to fill up the space indicated by such lines, and when the valve is opened by the tongue, the tendency of the former to collapse by its spring will make it impinge along on both sides of the polished surface of the tongue, and form a sufficiently air-tight joint.

Near to the crank axle *d* 1 is another axle, on which is a pinion *f f*, gearing into a cogged-wheel *g* 1, and on the same axle is a band-wheel or pulley *e* 1; if the latter, then flexible cords *e* 2 *e* 3 lay in grooves in the periphery in this pulley, and also in the grooves of a similar pulley fixed on the axle of the adjoining carriage B, and so in like manner from the axle of any one carriage to the axle of another. These cords bring into action, when the train is in motion, the adhesion of any of the wheels of the carriages, so that each carriage shall have sufficient adhesion to assist the impelling power in surmounting an inclined plane. In the ends of the locomotive engine are bolt holes *k* 1, which have screw-bolts projecting from the railway carriage, on which are nuts, by means of which the carriages may be forced asunder, so as to tighten and increase the adhesion of the cords.

It may be seen by a reference to the plan view drawing No. 2, that the arrangement of the slides *k k* which govern the action of the pistons, moving in the cylinders *g g*, differs in some degree from the arrangement of slides applied to steam cylinders. The former have the advantage of open heads for the free ingress of the atmosphere directly on to the top of the pistons, instead of the common method of leading to the heads of the cylinders by passages having three rectangular bends which occasion loss of power.

The slides *k k k k*, move on polished surfaces on the

sides of the cylinders indicated by the white surfaces at *h h*. In those sides but on the outside of the cylinders are open spaces or ways ten inches long by two inches wide, and leading to the top and bottom of the cylinders, and in the middle of these ways are other ways *h h*, of the same size, communicating with those ways but at right angles to them, and leading vertically into the expansion vessel *e e e*. In these are placed the throttle-valves *x x*, in end view. Two square apertures, equal in size to the ways, are made through the polished sides of the cylinders at top and bottom, the slides are boxes covering those apertures, these are moved backward and forward by the excentric rods *s s*, which are connected with the slide rods *m m*. The excentrics are so adjusted on the crank axle *d* 1, as that when the slide is back on one cylinder the other is forward on the other, when the piston in either cylinder is forced toward the straight axle, and the slide opens the aperture leading to the head of the piston whilst it closes it at the other end, and so opens the communication through the way *h* to the vacuum vessel *e e e*, which consequently draws the air out of the cylinder into it, whilst at the same time the atmosphere enters at the other end of the cylinder, forcing the piston down, which by its connecting rods turns the crank-axle and so gives motion to the carriage.

Operation.

To put the railway into operation and exhibit its action on a section of five miles; the pneumatic locomotive engine being placed in its proper position on the railway, and its tongue *p* being adjusted to the lips of the continuous valve, and the attending carriage with its band and brake-wheel being attached to the locomotive engine and the accompanying train being attached by their cords and pullies:—action must be given to the fixed steam-engine or other first movers and the exhausting air-pump connected with them, at the stations fixed at the extremities of a section of five miles. A self-acting station valve may be placed in the middle of the section, and similar valves must be placed at the extremities so as to confine the operation of the engine to *the section* along which the train may be passing at the time. The exhausting apparatus at the extremities abstracting the air from the main E, will rarify it and maintain it in a state of rarefaction throughout the whole section, to any required degree, and the degree will depend on the area of the cylinders, the weight of the load, the situation of the

railway, whether it be a level, an ascending or descending plane, and the speed of the train—the data for all which will be hereafter explained.

If the throttle-valves *z z*, end view, be then opened, a free communication will be established between the main E, the expansion vessel *e e*, and the cylinders *g g*, through the hollow tongue P, and the vertical passages *h h*, the air will be continually in a state of rarefaction in the vessel *e e*, as in the main E, and will be a reservoir of power for the cylinder *g g*, from whence the air, entering the cylinders and giving motion to the pistons, is drawn by suction. The pistons will now be put in motion and the rods *p p* connecting them with the crank axle *d* 1 *d* 1, will cause the crank to turn round the wheels fixed to it to revolve, and the locomotive engine to move forward the crank *d* 1, *d* 1 giving action to the excentrics S S, move the slides before mentioned at the proper moment and reverse the action of the pistons. Each stroke of either piston will cause the crank and wheels to turn half round, and a cylinder full of air will enter the vessel *e e*, and, passing through the hollow tongue P will enter the main E, and be thence drawn off to the stations of the fixed engine, from whence it will be ejected into the atmosphere.

As the locomotive engine moves forward or backward it carries with it the tongue P, the lower part of which is impelled along through the valve whose lips yield to it, and whose flexibility enables it to conform to the shape of the tongue and impinge along its surface, to which it is kept in close contact by its flexure and by the pressure of the incumbent atmosphere. As the tongue moves along the valve, it will open a passage at the forward edge of it, whilst the valve will continue to close after it, however great the speed of the tongue, which must be kept always lubricated, and will continually polish and preserve even the lips of the valve. The tongue is prevented from becoming hot from the friction of the valve, by the rapid current of *cold air* always rushing through from the cylinder *g g*. The retardation arising from the friction of the tongue and valve will be very slight: the resistance, or friction, of solids moving on solids of equal densities is proportional to the force of contact, pressure, or weight. Polished steel moving on polished soft iron is equal to about eight per cent. of the pressure, as we know by the friction of wheels turning on axles, therefore, if the tongue have eighty inches of rubbing surface on the valve, and if the valve press the tongue with a force equal to

one pound on the square inch, then the retardation from this cause will be equivalent to eighty pounds at all velocities, and this will be constant, whether the tongue move on a level or an ascending or descending plane. The ball and socket-joint by which the tongue is suspended allows it to yield to any vibratory motion of the engine, and the chains 13, 13, steady its action in the direction of the train. The horizontal wheels V V roll under the projections of the sides of the trough, and prevent the carriages from getting off the railway or overturning.

When it is desired to stop the engine, or cause it to move backward or forward, the lever of the friction-band brings it in contact with the brake-wheel and retards the motion of the locomotive engine, and by means of the bands or cords the wheels of any of the train to which they may be attached. These bands or cords bring into available action the adhesion of any of the wheels of a train and assist it over an ascending plane; when the motion is thus checked, the excentric rod *s s* should be lifted off from the cross axles *t t*, and by moving the vertical handles, *n n* drawing No. 1, in opposite directions the slides may be reversed, which will reverse the action on the cranks of the wheels, or the throttle-valves may be closed, when the pistons, compressing the included air in the cylinders, will act as a spring to retard the motion of the train.

The included air in the extended main, may be so abstracted, either from one extremity of the section or the other, or from both at the same time as that, the air entering the main from the piston cylinders, may move either in the direction of the train or in an opposite direction, or in both directions at the same time, the power of the locomotive engine will depend on the first mover, and the degree of rarefaction will always be greater near to the first mover; and as the locomotive engine approaches the middle of the section, it will be more equally acted upon by the first movers at the extremities of the section, and for this reason, the main may be smaller in the middle of the section. The locomotive engine always moving between and being acted upon by the fixed engines at both ends of a section, will, in proportion as it loses power by receding from one station, gain it by approaching another.

When the engine and train are about to descend a plane, the self-acting brake will be brought into action by reason of the platform of the carriage to which it may be attached declining from the horizontal to the inclined plane, and, in

consequence of the pendulum tending always to a vertical position, the pendulum-rod will bring the friction-band in contact with the periphery of the band-and-brake-wheel, and so retard the motion of the train. Thus, one brake will retard the wheels connected with it by the bands. A similar brake may be attached in like manner to any of the axles of any of the carriages or cars (as in B, fig. 1) of a train, and should be so adjusted, as that the friction-band of the brake shall press more or less hard, in proportion to the degrees of inclination of the plane; a chain (13) attached to any of the pendulums and leading to the engine, may assist this force of contact if required.

I am, dear Sir,
respectfully yours,
HENRY PINKUS.

London, Nov. 22, 1836.

(To be continued.)

HARWICH RAILWAY.

WE this month present our readers with a plan of the proposed Harwich Railway, and a map of the south-eastern part of England, with the opposite coast of the Continent of Europe; it was our intention to have entered into the merits of this line in the present number, but we received the plans at too late a period to do so fully, and, as they were unaccompanied by the section, we have thought it better to postpone our remarks upon it till the next month. The prospectus of the Company, however, which appears upon the wrapper, points out the objects of the undertaking, and may be thus briefly stated. To restore to Harwich (the most important packet-station during the war, and "the safest, the most commodious, and most easy of access," of any harbour on the eastern coast of the kingdom,) the advantage to which, from its proximity to the important ports of Antwerp and Rotterdam, and its peculiarly favourable situation for the trade of Hamburgh and the Baltic, it is fairly entitled, and of which it has been deprived by want of the means of internal communication. The time saved between London and the two former ports, will be, upon an average, at least twenty hours, and will in all cases prevent the necessity to passengers of passing a night on board; the Thames will then be relieved from nearly all the great

foreign steam-vessels, which are productive of so much loss of life and destruction of property. There is little doubt, too, that the Government will feel the necessity of re-establishing the packets at Harwich.

In an engineering point of view, the line is favourable; it has one peculiarity, that of being perfectly straight; and its only gradient is, we are informed, a very small one. It will, besides, be a very cheap line in its construction.—Ed.

STEAM-VESSELS IN THE POOL.

To the Editor of the Railway Magazine.

Sir,

Perhaps to any impartial person, giving his attention to the subject, it will appear to be a measure most strongly to be recommended to the Legislature, in consequence of the numerous accidents occurring by the steam navigation of the Pool, that when a branch from Deptford Pier to the Greenwich Railway shall be completed, steam-boats shall at least be restricted from navigating after dark between the said pier and London-bridge. Probably a total restriction would be an enactment not greater than is called for by the interests of the mass of the community. Be that as it may, the foregoing partial one, nothing but the paramount and absorbent feeling of apparent present self-interest could raise an objection to, deprecating, as all parties not so biassed must do, the dangerousness, nay, delay to passengers, entailed by the present course.

As your useful Magazine on the subject of locomotiveness, is not, I believe, exclusively confined to that by the railways, perhaps this simple memento of the existing state of these matters, and their to be hoped-for amelioration, may find a place in your next number, or occasion something from your own pen, more suited to the object in view,—that of calling public attention to so desirable an object.

I am, Sir, yours, &c.

London, Oct. 24, 1836.

BIRMINGHAM RAILWAY.

We lately cast our eyes on a passage in a letter addressed to us by the late Mr. George Julian, about eighteen months ago, in which he states that Sir John Rennie had surveyed a line for a railway from London to Birmingham, only about four miles longer than the one now constructing, free from tunnels, with excellent gradients, passing through a good line of country, and at an estimate of less than half that of the present line. Struck with this, and being informed that the present line has several (we believe eleven) tunnels, besides some bad curves, we have thought it of some importance to the public to inquire into it. At length we have obtained the following report by Sir John Rennie, which fully bears out Mr. Julian's statement, except that there seems to be one tunnel at Oxford, and that the estimate is not mentioned, which however we think from the trifling works to be executed could certainly not exceed 10,000*l*. or 11,000*l*. a mile, if so much.

In perusing this report we cannot help smiling at the magnifying medium through which Sir John Rennie then viewed cuttings and embankments of some 20 or 25 feet. Thanks to our present enterprise, works of such a magnitude are now dwindled into almost less than nothing.

But to return, if the statements in this document are true—and they certainly carry every appearance of it—why, we ask, was not this line adopted? Why has a million of money been spent more than is needful, and on a line apparently every way inferior, with near a dozen curses to boot in the shape of tunnels? We ask for satisfactory information, being unwilling to prejudge the question. If it can be given, it is well; if not we shall return to the subject, for we think it one of great public importance.—Ed.

Birmingham, 1*st April*, 1826.

Gentlemen,

In consequence of your resolutions of January, 1824, directing me to explore and survey the most practicable route for communication by means of a railway between London and Birmingham, I directed Messrs. John and Edward Grantham to explore the intervening counties, and take the

necessary levels for this purpose, and the whole of the spring and the greater part of the summer of last year was employed by them in making various trials through the country; but on account of the extensive and intricate nature of the survey, comprehending a district of above 130 miles, it was scarcely possible to complete this work in an effectual manner until the autumn following, when you determined not to proceed to Parliament this session (indeed the extended nature of the subject rendered this scarcely practicable). I should certainly have reported to you my opinion upon the progress made before, but have been prevented by illness from examining the line until the present. I now beg leave to apologise, and report my opinion upon the various trials and sections that have been made, although I am still in hopes that, in the event of your prosecuting the scheme, further improvements may be made, until the line becomes almost unexceptionable. By referring to the accompanying plan and sections it will be seen, that the line commencing at the Islington tunnel of the Regent's Canal, rises 10 feet to the mile for 3 miles, and continues from thence nearly parallel to it, and skirting Regent's Park pursues a tolerably direct line until arriving at the Edgeware-road, a distance of 3 miles, rising 30 feet, or 10 feet to the mile; but to obtain these inclines considerable obstacles must be encountered, namely, two miles of 23 feet of average cutting from the Hampstead to the Edgware-road. The property, moreover, here is extremely valuable, and mostly laid out for building-ground, and several nearly new houses must be sacrificed; indeed, here, the greatest part of the difficulty occurs; but by assuming steeper inclines and taking a wider range of London, a considerable portion of these may be avoided, or the line may be stopped at the Edgeware-road for the present; from thence to the river Brent, a distance of 4 miles, the line continues rising 16 feet, two of which are level, the remainder rising 8 feet to the mile; to obtain this it will be necessary to embank about ¾ of a mile, averaging 9 feet high, and for ½ a mile over the Brent, averaging 30 feet high, the remaining distance of 2¾ miles being little more than surface-forming. Thence the line takes a direction to the east of Harrow and by Harrow Weald, and crossing the road to Rickmansworth, a distance of 8½ miles, rising 14 feet to the mile in this division, except the cutting at Oxley-lane, which will average 28 feet high for a quarter of a mile, little more than surface-forming and some small pieces of cutting and

embankment will be necessary, nor will any gentleman's park or pleasure-grounds, or other valuable property, be affected by it; from thence to Otter's Pool, a distance of 4 miles, the line continues level, passing to the east of Pinner-wood, and crossing the turnpike road about ¼ of a mile from the town of Watford, and without interfering with any valuable property; in this division the levels are rather irregular, although the cuttings and embankments are by no means serious. The total distance from London is 18 miles, and the distance by the turnpike road is about the same. From Otter's Pool to Hunton-bridge, a distance of 3½ miles, the line continues rising at the rate of 15 feet to the mile, crossing the vale of the Colne by a heavy embankment ¾ of a mile long, averaging 30 feet high, and a piece of heavy cutting at Leavesiton-green, averaging 50 feet high for ¾ of a mile; these no doubt are serious obstacles, independent of the circuitous course. The town of Watford, however, and the park and pleasure-grounds of the Earl of Essex intervening, render it almost impracticable to obviate these difficulties entirely, although I have reason to believe that by increasing the inclines, it may be materially improved. Finding the articles abovementioned, and wishing at the same time to avoid the Grand Junction canal, I directed Mr. Edward Grantham to pursue the course of the St. Alban's Valley; this, however, proved to be unsuccessful, as the high lands beyond St. Alban's would have rendered its further continuance almost impossible at any reasonable expense. From Hunton-bridge to the summit at Dagnall, a distance of 11¾ miles, the line continues rising gradually at the rate of 12 feet to the mile, passing to the north of Abbot's Langley, Hemel-Hempstead, and Gaddesdon, but in order to preserve the above-mentioned gentle inclination, it was necessary to keep the line as near as possible hanging upon the sides of the adjoining hills, the section in consequence shows generally a rugged and an uneven surface, on accouut of the numerous ravines which constantly run down from the main chain of hills, the cuttings and embankments for 6 miles, to Pitchett's End, although apparently heavy as shown upon the section, are nevertheless of short duration; near Gaddesdon, Gaddesdon Park intervenes, and cannot be entirely avoided without much difficulty, although, as the line here nearly skirts that part adjoining the road, I should not apprehend any reasonable objection; with this exception no other valuable public or private property is interfered with, indeed the country generally is extremely open, and the land by no means

valuable: by increasing the inclination in some places to 15 and others 20 feet to the mile, the whole of this district may be improved and shortened. At Dagnall the summit must be passed by a piece of heavy cutting, averaging 28 feet for one mile long.

[To be continued.]

REVIEW OF BOOKS.

"*A Practical Treatise on Oblique Arches,*" by John Hart, mason, has just appeared, which at this time seems to be much wanted. It is written in a plain unaffected style, has some good plates, and is well suited for practical purposes.

"*Fifth Report of the British Scientific Association.*"—This volume appeared about the time of the last meeting at Bristol; and, like its predecessors, contains some very excellent reports on various branches of science.

"*A Report by Mr. Whewell, on Electricity, Magnetism, and Heat,*" gives a very luminous view of the present state of these sciences, particularly abroad, which renders it the more valuable to British philosophers. A Report in French, by Mons. Quetelet, on the state of the mathematical sciences in Belgium, contains, in the sketch he has given, a lively picture of the labours of several individuals hardly known in this country. The mathematical and physical sciences do not seem to have made any great stride in Belgium. Geology alone, the youngest of all the sciences, M. Quetelet says, has received a happy impulse.

"*A Third Report is on the Phenomena of Terrestrial Magnetism, from Professor Hansteen,*" by Capt. Sabine.—It is well known that the philosophical world has been divided in its opinion, as to whether the phenomena of dip, variation, and intensity, can be accounted for on the supposition of one or two magnetic axes in the earth. M. Hansteen and Capt. Sabine, after a careful discussion of the most trustworthy observations, decide in favour of two axes of unequal force. These axes, according to this Report, are severally about one-third the length of the earth's axis, and the ratio of their forces is that of 1·7724 to 1. Their exact position does not seem to be settled, but the poles of the stronger are about Hudson's Bay and Van Dieman's Land; of the weaker, about Siberia and Terra del Fuego. In this part of the world the dip is at present diminishing about 3 minutes annually; in the Gulph of Guinea 10 minutes; while in the China seas, between 1700 and 1780, it increased about 15 minutes yearly. Mr. Hansteen is now employed in preparing his own and other observations for publication. At Paris, Nov. 9, 1835, the variation westerly was 22° 4′,

and the dip, July 3d, was 67° 24'. At London, the dip at that time was 69° 19'.

M. Hansteen believes the cause of the magnetic phenomena to be external, not internal, with regard to the earth. [Our opinion is, that it will be found to arise from the inequality of temperature of the earth.—Ed.] M. Hansteen also gives the following law, which he conceives to be supported by the experiments of himself and Professor Steinhausen, namely, "That the force in a lunar magnet increases as the square of the distance from the middle point."

Next to the Reports, follow the "Researches undertaken at the request of the Association." The first is by Mr. Francis Bailey, on the Comparative Measurement of the Aberdeen Standard Scale; the second, an elaborate one, on the "Impact upon Beams, by Eaton Hodgkinson;" the third, a still more elaborate one, on the "Direction and Intensity of the Terrestrial Magnetic Force in Ireland, by the Rev. Humphrey Lloyd;" the fourth, an interesting report on the "Phenomena usually referred to the Radiation of Heat, by Henry Hudson." This paper is deserving the attention of those who are studying the phenomena of radiant heat. The fourth is a "Third Report of Experiments on the Quantities of Rain falling at different Elevations above the ground, at York, by Wm. Gray, Jun. and Professor Phillips." It has long been known that the quantity of falling rain, in any one place, is less the higher we ascend, which at first was exceedingly puzzling to philosophers. On the ground at York, the quantity fallen is sometimes above 50 per cent. more than that above the top of the Minster, or 242 feet high; the mean annual ratio is about 100 to 59. According to the experiments of the above gentleman, the difference at different heights is very nearly as the square root of the height; but it does not appear that it follows precisely the same law every year, and every season of the year.

These facts would be easy to explain on the principle of continual accession and condensation of vapour, as the drops descend through the air, if there was not another fact, showing that it is not the depth of atmosphere which is the cause, but the height relative to the surface of the earth. Mr. Barrington, for example, has shewn that the quantity of rain on the ground of Mount Renni, 1350 feet high, is sensibly the same as in the plain a mile distant, through a period of several months.

A laborious report follows, on the "Hourly Temperature at Plymouth, by W. S. Harris," in which it appears that the daily maximum temperature is about 1 P.M., and the minimum about 5 A.M. Other valuable reports succeed, chiefly relating to medical subjects; and the volume closes with careful abstracts from the various communications made on a vast variety of interesting subjects.

The value of these volumes, we think, would be much enhanced

if, in the various reports, all the known phenomena were collected together, and properly arranged, with clear sketches of the experiments. Historical and theoretical observations might then be easily added. By this means, readers would be put in speedier possession of what is known, and be more easily able afterwards to follow the arguments. A part of Mr. Lloyd's Report on Physical Optics, in the previous volume, is very elegant in this respect.

MR. STEPHENSON'S EVIDENCE ON THE BRIGHTON LINE.

[Continued from p. 275.]

[We have given all the main points of the direct evidence of Mr. Stephenson, with the questions at length; but the space occupied is so much more than we can spare, that in all future cases we shall be compelled to follow some such plan as that which we did in the last Number with Mr. Walter's evidence. Most of our readers will, in all probability, prefer this, as it will save them the tedium of wading through the long questions of counsel, and reiteration in the answers.—ED.]

Assuming that you do go further round, have you any doubt of the expediency of that line, in order to avoid the higher ground?—I have no doubt at all about it.

Has your attention been long called to this subject?—Yes.

Your object is to get to Brighton with the greatest facility?—Yes, under all the circumstances.

Is the line which you have taken, in your judgment that by which you can effect that object with the greatest certainty?—Yes.

When you are laying down a line of railroad, do not commerce and traffic and the actual use of the railroad form a considerable element?—Yes, certainly.

Have you taken that into consideration, in laying down this line by the Dorking and Adur valley?—Yes; but if the other had been rather more inhabited I would have preferred this in an engineering point of view; I mean, that it would have required a very large increase in the population, on the direct line, to have influenced me in taking that. I would have preferred (unless the population upon the direct line had been very great) the Mickleham line.

Now the question I was asking you was, did you take into calculation the commercial and agricultural advantages of the Dorking Line?—I had a view to that.

Did they induce you to hesitate at all, or confirm you in wishing to adopt that line?—They confirmed me; both the engineering and commercial view, I think, went to confirm that.

And induced you to adopt that line?—Yes.

Taking any one common point from London,—I would take Nine Elms, for instance, or perhaps the foot of Vauxhall-bridge, —5 miles you say is the distance from London to Wimbledon, is it not?—About 5 miles.

And from Wimbledon to the terminus near Brunswick-square at Brighton, what is the distance?—Forty-nine miles and 50 chains.

That is the whole length of the main line you are seeking to make under the proposed Act of Parliament, from Wimbledon-common to Brighton, to Brunswick-square?—Yes.

Will you tell me what is the length of the branch which takes you to the north part of Brighton?—I have not got it put down here.

Have you not the plan before you?—Yes; it is little exceeding a mile and a half. [*Witness refers to plan.*]

The whole length of the branch would a little exceed a mile and a half?—Yes.

How far from Brighton at the terminus at Brunswick-square is it thence westward that the branch breaks off?—That is also very nearly the same distance; it is a mile and 25 chains. The distance from Wimbledon to the terminus at Brunswick-square is 49 miles and 50 chains; then it is about 8 chains more to the northern terminus.

Then I understand you, having given the distance from Wimbledon to the depot near Brunswick-square as being 49 miles and 50 chains, if instead of any person taking that line they take the branch, they go 8 chains further?—Yes; 8 chains is the tenth of a mile.

Will you have the goodness also to tell me what is the distance from Wimbledon-common to Nine Elms, by the Southampton Railroad, which you use?—It is about 5 miles and 40 chains.

Those two sums added together will show the length of the railroad that you mean to make, and the length of the Southampton Railroad that you mean to use, and will give the whole extent of ground passed over by passengers going from Nine Elms to Brighton?—Yes.

How far is it from Nine Elms to Vauxhall-bridge?—I cannot say; perhaps it may be 150 yards, somewhere thereabouts.

Speaking of the water, there are two or three houses, or yards, or manufactories, or something of that kind, between Vauxhall-bridge and the wharf to which they go?—Yes, there are.

In order to get to it from Vauxhall-bridge, you would have to go out into the turnpike-road, to go round some few houses, and so get to the station?—Yes, but it is very near; I cannot say how far it is off, but it is not more than I state.

Can you tell me (I am speaking of course with respect to the ordinary traffic; I do not mean the extreme speed at which you could go upon the railroad), what will be the time taken in going from Nine Elms to the depot at Brighton?—It may be

gone in an hour and three quarters, and two hours at the very utmost.

And what would be the ordinary average?—I would call the ordinary average two hours.

The other branch will make hardly a fraction of time difference? —Very little.

And therefore the journey to either terminus will be completed in two hours?—Yes; it might be at least, and I think they will run at that.

Supposing a direct line could be obtained (I will put aside engineering difficulties of every kind) to Brighton, which should be seven or eight miles shorter than your line, what upon the whole line of road would that make a difference of?—That would depend upon the inclinations that were taken upon the direct line.

Then I will put it in the most favourable view, I will suppose equal gradients?—That is the difference of eight miles in motion; it would be about a quarter of an hour.

Having had your attention generally, for I am not able to go into any particulars, but having had your attention drawn generally to other lines passing between London and Brighton, and having seen, as I understand, the facility of the gradients upon your line, what in your judgment would be the difference in time by any line going in another direction from the one you have adopted from London to Brighton?—I have considered the matter a good deal, and I think the time would be about the same.

You are assuming that other lines, having had your attention drawn to it, would have such unfavourable gradients, that you conceived that that would eat up the difference in distance and time between your line and any other more direct line?—I think so.

I have asked you with respect to time on the line; applying your attention to the same considerations, that is to say, having looked generally to the country intervening between Brighton and London, and considering the difficulties and so on, in your judgment will your line be, or not be, the cheapest line for conveyance simply?—I have no question, from experience, that the cheapest line would be that which has the lowest gradients, in spite of the additional distance, referring especially to this case.

I presume the cheapness will arise from the moving power and the engines which are used being able to be worked at less cost? —Yes, it will; as well as the road being also maintained at less cost.

One of the material ingredients with respect to the expense of carriage upon the line will be, I take it, the repair of the engines, and the irregularity of the power that is to be applied to get over any irregularity in the gradients?—Yes, precisely.

I think I collected from you that the line from Shoreham to Brighton is nearly a level?—Yes.

Is that a work that can be very easily executed?—Very.

And quickly?—And quickly.

In your judgment in what time would that work be completed? —It might be done in six months.

Could it be done in six months in such a manner as to afford an opportunity of coals being taken from Shoreham to Brighton? —Yes, I think so; when I say completion in six months, that is excluding the branch to the north.

How long would the completion of the other branch occupy? —Three months more.

There is an important inquiry in these resolutions, namely, what planes on the railway are proposed to be worked either by assistant engines, stationary or locomotive, with the respective lengths and inclinations of such planes; are there any such planes upon your line at all?—There are none.

You will not then call in aid either stationary engines or assistant engines?—Certainly not.

Your same locomotive power will carry you from Nine Elms to the termini at Brighton?—Yes.

Are there any peculiar engineering difficulties in your proposed line?—I do not think that there are.

As an engineer would you say that the engineering difficulties are less than usual?—Certainly.

I have asked you of the means of ventilation of the tunnels in your line; are the gradients and curves, generally speaking, favourable?—I consider them favourable.

Can you tell me at this moment what is the steepest gradient you will have?—Sixteen feet in a mile; 1 in 330.

That is an useful gradient for a locomotive power?—Yes, they may be used advantageously upon that inclination.

By the Committee.—You stated that the difference between the northern branch and the other branch was 8 chains; is that so?—I have it not noted down here, but I have measured it, and I do not make the difference quite so much as 8 chains.

By Mr. Sergeant Merewether.—Mr. Stephenson will ascertain that when there is a little intermission. Will you tell me what is the smallest radius of any curve upon your line?—A mile and a half.

Is that a perfectly useful and convenient radius for passing of locomotive engines?—It is very convenient.

Even for passengers?—Yes.

Are there many railroads now in work which have much less curves than those?—Very much less.

Generally, in an engineering point of view, do you speak with confidence of the fitness of this projected line of railroad?—I think it is a very fit line in an engineering point of view.

Has this railroad to pass any turnpike-road on a level?—Mr. Bidder speaks to that.

May the whole of the works, mainworks and branches, be executed within two years and a half?—Yes; I mean that the whole period will be two years and a half.

Have you now measured, with respect to the length of the two branches?—Yes. I see that I mistook the point of the main section from which the branch left, and the difference in length is 58 chains.

How much longer will that take in passing; will it be as much as a minute?—About three minutes, perhaps.

NEW REGULATIONS OF THE LORDS WITH RESPECT TO RAILWAY BILLS.

NEW STANDING ORDERS WITH REGARD TO RAILWAY BILLS.

[Continued from p. 341.]

8. That parties desiring to renew (in the then next ensuing session) any application to Parliament in respect of any railway, the plans for which shall have been deposited, and the notices for which shall have been given as before directed, shall be permitted so to do, provided that no one deviation shall exceed one mile in length, and provided a plan and section of such railway, together with a book of reference thereto, shall be deposited with the clerk of the peace, and a plan and section, so far as relates to each parish, together with a book of reference thereto, with the parish clerks of the several parishes through which such railway is proposed to be made, on or before the 30th day of November in the year immediately preceding that in which such application is intended to be made; and that the intention to make such application shall be advertised, in manner next before directed, in September, October, and November; and that personal application shall be made to the owners or reputed owners, lessees or reputed lessees, or in their absence from the United Kingdom to their agents respectively, and to the occupiers of the lands through which any such railway is proposed to be made; which application in writing shall point out the particular land or building belonging to such owners or reputed owners, lessees or reputed lessees, which are purposed to be taken for the purpose of such railway, and shall also state whether such railway is intended to pass through such land or building upon the level or upon an embankment or cutting, with a reference to the number on the plan deposited with the clerk of the parish wherein such land or building is situated.

9. That the clerks of the peace or their respective deputies do make a memorial in writing upon the map or plan, section, and book of reference so deposited with them, denoting the time at which the same were lodged in their respective offices, and do at

all seasonable hours of the day permit any person to view and examine the same, and to make copies or extracts therefrom, such person paying for the same the sum of one shilling for every such inspection, and the further sum of one shilling for every hour during which such inspection shall continue after the first hour.

10. That within one calendar month from the time when the map or plan and section shall have been deposited with the clerk of the peace, a copy of so much of the said map or plan and section as relates to each parish, through which any railway is intended to be made, varied, extended, or enlarged, together with a book of reference thereto, shall be deposited with the parish clerk of each such parish in England, the schoolmaster of each such parish in Scotland, and the postmaster of the post town in or nearest to such parish in Ireland, for the inspection of all persons concerned, at all seasonable hours of the day, such person paying for each inspection the sum of one shilling.

11. That within one calendar month from the time when the map or plan and section shall have been deposited with the clerk of the peace, a copy of the said map or plan, section, and book of reference shall be deposited in the office of the clerk of the Parliaments, and that a memorial in writing of the receipt thereof be indorsed by one of the clerks of the said office upon such map or plan, section, and book of reference.

12. That before any application is made to Parliament for a bill for making any railway, or for varying, extending, or enlarging any railway already made, previous application in writing be made to the owners or reputed owners, lessees or reputed lessees, by being sent to their usual place of abode in the United Kingdom, or, in their absence, to their agents respectively, and to the occupiers of the lands through which any such railway is intended to be made, varied, extended, or enlarged; which application in writing shall point out the particular land or building belonging to such owners or reputed owners, lessees or reputed lessees, which are purposed to be taken for the purpose of such railway, and shall also state whether such railway is intended to pass through such land or building upon the level or upon an embankment or cutting, with a reference to the number on the plan deposited with the clerk of the parish wherein such land or building is situated; and that such applications shall be made on or before the 31st day of December, in the year immediately preceding that in which the application for a bill is intended to be made; and that separate lists be made of the names of such owners, lessees, and occupiers, distinguishing which of them, upon such application, have assented to or dissented from such intended railway, or such variation, extension, or enlargement, or are neuter in respect thereof: provided always, that no power shall be granted in any private bill relating to railways to deviate from the line laid out, without its being specified in the advertisement that such a power will be applied for, and to what extent.

13. That before any such bill shall be read a second time in this House for making any railway, or for varying, extending, or enlarging any such railway already made, the lists mentioned in the preceding resolution, and an estimate of the expense, signed by the person making the same, and a copy of the subscription contract after mentioned, together with a statement of any alterations from the book of reference which may have arisen since the same was deposited, be lodged in the office of the clerk of the Parliaments, and that the receipt thereof be acknowledged accordingly by one of the clerks of the said office.

14. That no such bill shall be read a third time unless the committee upon the bill shall report that a subscription to the amount of five-sixths at the least of the estimated expense shall be entered into by persons under a contract binding themselves, their heirs, executors, administrators, or assigns, for the payment of the money so subscribed.

15. That no such bill shall be read a third time in this House unless provision be made—

(1.) That no such Company shall be authorised to raise, by loan or mortgage, a larger sum than one-third of their capital; and that until fifty per cent. on the whole of the capital shall have been paid up, it shall not be in the power of the Company to raise any money by loan or mortgage.

(2.) That where the level of any road shall be altered in making any railway, the ascent of any turnpike road shall not be more than one foot in thirty feet, and of any other public carriage road not more than one foot in twenty feet; and that a good and sufficient fence of four feet high at the least shall be made on each side of every bridge which shall be erected.

(3.) That no railway whereon carriages are propelled by steam shall be made across any turnpike road or other highway on the level, unless the Committee on the bill report that such a restriction ought not to be enforced, with the reasons and facts upon which their opinion is founded.

PROPOSED STANDING ORDERS WITH REGARD TO THE PROCEEDINGS OF COMMITTEES ON RAILWAY BILLS.

1. That committees on railway bills do inquire into the following matters previous to the question being put upon the preamble; and that they report specially thereupon, except in the cases hereafter provided:—

(1.) As to the proposed capital of the company formed for the execution of the project, and the amount of any loans which they may be empowered to raise by the bill; the amount of shares subscribed for, and the deposits paid thereon; the names and places of residence of the directors or provisional committee, with the amount of shares taken by each; the number of shareholders who may be considered as having a local interest in the line, and the

amount of capital subscribed for by them; and the number of other parties, and the capital taken by them; a statement of the number of shareholders subscribing for 2,000*l.* and upwards, with their names and residences, and the amount for which they have subscribed.

(2.) The sufficiency or insufficiency for agricultural, commercial, manufacturing, or other purposes of the present means of conveyance, and of communication between the proposed termini, stating the present amount of traffic by land or water, the average charges made for passengers and goods, and time occupied.

(3.) The number of passengers, and the weight and description of the goods, expected upon the proposed railway.

(4.) The amount of income expected to arise from the conveyance of passengers and goods, and in what proportion; stating also generally the description of goods from which the largest revenue is anticipated.

(5.) Whether the proposed railroad be a complete and integral line between the termini specified, or a part of a more extended plan now in contemplation, and likely to be hereafter submitted to Parliament, and to what extent the calculations of remuneration depend on such contemplated extension of the line.

(6.) Whether any, and what, competing lines of railroad there are existing, and whether any, and what, are in progress or contemplation; and to state, so far as circumstances will permit, in what respects the proposed line is superior or inferior to the other lines, if there be any: Provided always, that no line of railway shall be deemed a competing line in contemplation unless the plans and sections for the same, such as are required by the standing orders of 1836, respecting railway bills, shall have been deposited with the clerk of the peace, and in the office of the clerk of the Parliaments on or before the first day of March then last past.

(7.) To state what planes on the railway are proposed to be worked, either by assistant engines, stationary or locomotive, with the respective lengths and inclinations of such planes.

(8.) To advert to any peculiar engineering difficulties in the proposed line, and to report the manner in which it is intended they should be overcome.

(9.) To state the length, breadth, and height, and means of ventilation, of any proposed tunnels, and whether the strata through which they are to pass are favourable or otherwise.

(10.) To state whether, in the lines proposed, the gradients and curves are generally favourable or otherwise, and the steepest gradient, exclusive of the inclined planes above referred to, and the smallest radius of a curve.

(11.) To state the length of the main line, of the proposed line of the railroad, and of its branches respectively.

(12.) To state generally the fitness, in an engineering point of view, of the projected line of railroad.

(13.) If it be intended that the railroad should pass on a level any turnpike road or highway, to call the particular attention of the House to that circumstance.

(14.) To state the amount of the estimates of the cost or other expenses to be incurred up to the time of the completion of the railway, and whether they appear to be supported by evidence, and to be fully adequate for the purpose.

(15.) To state what is the estimated charge of the annual expenses of the railroad when completed, and how far the calculations on which the charge is estimated have been sufficiently proved.

(16.) Whether the calculations proved in evidence before the Committee have satisfactorily established that the revenue is likely to be sufficient to support the annual charges of the maintenance of the railroad, and still allow profit to the projectors.

(17.) The number of assents, dissents, and neuters upon the line, and the length and amount of property belonging to each class traversed by the said railroad, distinguishing owners from occupiers; and in the case of any bill to vary the original line, stating the above particulars with reference to such parties only as may be affected by the proposed deviation.

(18.) To state the name or names of the engineers examined in support of the bill, and of those, if any, examined in opposition to it.

(19.) To state the main allegation of any petition or petitions which may have been referred to the Committee in opposition to the preamble of the bill, or to any of its clauses; and whether the allegations have been considered by the Committee, and if not considered, the cause of their not having been so.

(20.) To state, in addition, any circumstances which, in the opinion of the Committee, it is desirable the House should be informed of.

2. That this House will not proceed, except in the cases hereafter provided, with the further consideration of report of any bill until it has received from the Committee specific replies in answer to each of the questions contained in the first of these proposed resolutions.

3. That the clerk of every Committee on a Railway Bill do take down the title of every Lord attending the Committee on each day; and if any division shall take place in the Committee upon any of the matters which the Committee are directed to inquire into by the preceding resolution, or upon the special report in respect of such matters, the clerk do take down the titles of Lords voting in any such division, distinguishing on which side of the question they respectively vote; and that such lists be given in with the report to this House.

4. That in those cases where no parties shall appear in support of a petition in opposition to any bills for railways before this

House, it shall be in the discretion of the Committee to determine how far it may be necessary to inquire into the facts required to be proved by the first of these proposed resolutions.

Although the Committee are of opinion that it may be expedient to consider in another session how far these orders, or any of them, may be made applicable to cuts, canals, waterworks, aqueducts, tramroads, tunnels, or archways, bridges, ferries, docks, piers, or harbours, they are not prepared, without fuller consideration, to recommend any present alteration of the orders relating to bills of this description.

SCIENTIFIC AND MISCELLANEOUS INTELLIGENCE.

Machines to imitate the Human Voice.—Professor Wheatstone described and repeated the experiments of Kratzenstein, Dr. Kempeler, the Abbe Mical and Mr. Willis. Dr. Kempeler's speaking machine was exhibited, and made to pronounce many words and a few short sentences.—*Fifth Report, British Scientific Association.*

Radiation of Heat. Dr. Hudson's Experiments.—"For the purpose of repeating Leslie's experiments with variations of the temperatures of the surface of the mirror and of the thermometer, the author procured a parabolic zinc mirror, with a hollow back, so that its surface could be heated or cooled by filling it with hot or cold liquids.

"The following are the results obtained:—1st. Whatever be the temperature of the room, if the mirror and canister be at the same temperature also, there is no effect produced by either the metallic or the varnished side of the canister. 2nd. If the canister (alone) be above the temperature of the air, the varnished side produces a greater heating effect than the metallic side, in the proportion of about 12 : 1. 3rd. If the canister (alone) be below the temperature of the room, the varnished side produces a greater cooling effect than the metallic, in the same proportion of about 12 : 1. 4th. If the mirror be heated considerably, (say to 200° Fahr.), and thermometer so arranged that both balls are equally warmed by the mirror (one of them being in focus), a canister (at the same temperature as the room) produces a cooling effect on the focal ball, and the varnished side displays its superior efficiency. 5th. The mirror and thermometer being as in the last experiment, the canister was heated 10 or 12 degrees beyond the temperature of the room. The effects were now found to vary according to the distance of the canister from the mirror; at a short distance it acted as a cold body, and the varnished side most efficient: on increasing the distance, the effect diminished, and at a certain point

altogether ceased; the thermometer marking zero, whether the varnished or metallic side was towards it; but on increasing the distance, the canister began to act as a warm body, and again the varnished side displayed its superiority. 6th. When the focal ball (merely) was cooled by the evaporation of water, or even of æther, neither side of the canister produced any change in the effect. 7th. When the focal ball was cooled 27° Fahrenheit (by evaporation of æther), and the canister cooled 16° of Fahrenheit (being of course 11° warmer than the focal ball), the focal ball was now cooled more than previously, as if the canister were (comparatively) a cold body."

Discoveries since 1766.—The steam-engine improved, 1769. Spinning by steam, 1782. Air-balloons, four new planets, recovering drowned persons, suspenders, umbrellas, and cut nails, 1792. Hydraulic press, and telegraphs, 1794. Percussion powder, Galvanism, the names in chemistry, 1803. The Argand lamp, boring for water, coal, &c., 1804. Roman cement, gas-light, 1813. Sugar cultivated in Louisiana, 1809. Navigation by steam, 1810. Printing by steam-power, stereotype plates, circular saws, sugar from the root of beet, anthracite coal, lithographic impressions, 1816. Musical boxes, 1817. Safety lamps, chain cables, 1820. Chronometers perfected, power looms for cloths, stockings, &c., treadmills for prisons, the stomach pump, railways, lead and coal mines in the U. S., craniology, 1828. Steam guns and carriages, 1832. Gum elastic shoes and boots, 1833.—*Mining Journal.*

We congratulate the readers of this journal on the improvement it has lately exhibited in its notices of scientific subjects. It is a good sign when a writer increases the size of his paper 50 per cent. and fills it with matter of a superior order and really useful.—Ed. *Railway Magazine.*

Steam Navigation to America.—The British and American Steam Navigation Company have recently concluded contracts for the immediate fitting out of a Steam Vessel, which is to ply between the ports of London and New York. The vessel is to be (140 feet between perpendiculars), 150 feet length on deck, and 40 feet breadth of beam. The total width over the paddle boxes will be about 68 feet. Tonnage of the vessel about 1890 tons. Messrs. Curling and Young are the contractors for this stupendous ship, to be built and rigged in the Thames, whence she is to sail to Glasgow for her machinery. The engines are of a magnitude far surpassing any engine ever before attempted as marine engines, being 76 inches diameter of cylinder, and 7 feet length of stroke, with metallic pistons. Messrs. Claud Girdwood & Co. of Glasgow are the contractors for the engines. The boilers will be altogether under the water line, and the coal room (for 600 tons) above the boilers. The ship will have an upper deck, main deck, and orlop decks. It is calculated that if she only makes 200 miles in 24 hours, or 8⅓ miles per hour, which is less than the speed of the smaller boats steering between Scotland and the Thames, that her

outward passage will be accomplished in 15 days, and her homeward passage in 12 days. It is however to be expected that so large a ship will attain a much higher average speed, and consequently, that she will accomplish her voyage in much less time than we have mentioned. The above statement of facts furnishes a remarkable instance of British enterprise, creditable alike to the promoters, and to the builders and engineers who have engaged in the practical execution of so unprecedented an undertaking.

Falling Stars.—A great interest was excited among Astronomers to ascertain whether these bodies, which have been noticed in our Magazine, p. 188, as having appeared about the 12th of Nov. in immense multitudes in various parts of the world, would re-appear, M. Arago having started the idea that they can be no other than small bodies revolving like planets about the sun, which at this period come so near the earth as to pass through its atmosphere, inflame, and thus become visible. It is said about 150 appeared during the night of the 12th at Paris, confined to no particular part of the heavens, but chiefly seen in the constellations of "the Lynx, the Great and Small Lion, Ursa Major, Giraffe, and Great Dog." In this neighbourhood, London, also a great number, we have been informed by parties who were out, appeared. We must, however, again observe, that as to being bodies moving independently about the sun, and passing periodically through our atmosphere, we believe to be impossible. The action of the earth at any such a distance would become so enormously great as to destroy the figure of the orbits altogether, and prevent the possibility of such periodic returns.

Sash suspender.—A very simple but ingenious contrivance, which has been patented, is exhibited in the Adelaide Gallery, for detaching the line from the sash, for the purposes of cleaning, glazing, and painting window sashes. It is both efficacious, and trifling in its cost.

On the Influence of the Artificial Rarefaction or Diminution of Atmospheric Pressure in some Diseases, and the Effects of its Condensation or increased Elasticity in others. By Sir James Murray.—The paper was divided into two parts. The first detailed the general principles of the rarefaction of air, and its powers as a remedial agent on the human body. The second part related to the local agency of condensation of air in topical diseases.

The propositions were submitted, not as remedial means of themselves alone, but as auxiliary to those already in use. It was shown that the ordinary atmospheric pressure sustained by the whole body averages 15 tons; that by placing a person in an air-tight bath, with provision for breathing the ordinary atmosphere, half a ton or a ton can be removed without danger:

That the abstraction of this elastic compression permits the easier expansion of the chest, elicits the blood and animal heat to the surface of the body, opens the pores of the skin, and restores to the surface rashes or eruptions which had been suppressed.

It was therefore submitted, that an agent capable of producing

such effects is entitled to consideration, in treating certain conditions of pectoral diseases; in eliciting internal congestion or inflammations from central organs to the surface; in preventing certain fevers and other complaints arising from obstructions of the cutaneous functions; in translating gout and rheumatism from vital organs to the limbs; in restoring a due balance of the circulation, and attracting the blood into the superficial veins from the deep seated arteries.

A case of a patient was detailed in which congestion of the brain was diverted from the head by inclosing one of the lower extremities in a rarefying bath, and abstracting about two pounds and a half of pressure from each inch of the surface: the influx of the fluids was so great that in two hours the circumference of the limb was increased nearly three inches, the vessels of the skin rendered red, warm, and turgid, and the head relieved.

The case of a painter was also induced, whose right arm had long been paralysed and cold from the effects of lead paint. The arm was put for two hours into rarefying case, and afterwards continued hot and vigorous, so that the man was able to resume his work.

Part Second.—As diseases of an opposite nature require opposite remedies, the principle of rarefaction is reversed in certain cases, and condensation, or additional pressure, employed.

This part of the paper detailed several cases illustrative of the powers of this agent. Where there was too much vascularity of parts, then local pressure, pumped under an air-tight covering emptied the vessels, propelling onwards the overflow of blood contained in the veins and preventing its undue flux by the arteries.

The consequences were, to diminish inflammations, dissipate tumours and white swelling, facilitate the reduction of hernia and other protrusions, and to diminish the influx of fluids into indurated breasts or enlarged glands.

The author adduced a very interesting case, the reduction of a *prolapsus ani* by atmospheric pressure, without touching or bruising the *sensitive* intestine.

The powers of condensation of air were then alluded to, for the treatment of fungous sores or ulcers, and for the suppression of uterine hæmorrhages, as well as bleeding from wounds or lacerations.—*Fifth British Scientific Association Report.*

Newtonian Rings of Light contract by Heat.—Professor Powell made an experiment by which it appears that the Rings of Light formed by laying two glasses together touching in the centre and of different curvature—known by the name of Newton's Rings—contract as the temperature of the glasses rises. This he attributes to the repellent power of heat separating the glasses a little. Why may not the cause be the increase of that force by an increase of the temperature which causes the fits, which is doubtless the same force that produces refraction? We shall thus reduce to one cause this phe-

nomenon, and that increase of refraction, by an increase of temperature, observed by Euler.

Balloon Voyage.—The following from the *Times* is the best account we have yet seen of the aerial voyage of Messrs. Green, Monck Mason, and Holland, from London to Weilburg, near Coblentz, a distance of about "480 English miles." Nothing is said of any effect on the balloon in crossing the channel. We are surprised at this, as, when Messrs. Blanchard and Jeffrey crossed in the same line, (from an account we remember to have read,) the great levity of the air over the water, no doubt owing to its specific gravity being so much diminished by admixture with the vapour from the water, put them in imminent danger of falling into the sea. Their ballast soon went, their provisions, their last bottle of spirits and clothes followed, and they were in the act of lashing themselves to the cords of the balloon and cutting away the car, when they came into a drier and heavier atmosphere near the coast, and of course rose, and landed in nakedness and destitution.

The following narrative has been received from Mr. Holland:—

"Time, half-past 1 o'clock, ascended: 12 minutes before 3, crossed the Medway, leaving Rochester about six miles to the left; 5 minutes after 4, passed two miles to the right of Canterbury; quarter after 4, saw the sea; 12 minutes before 5, left England about one mile east of Dover Castle; 10 minutes before 6, over France, I think two miles east of Calais. It began to be very dark about 10 minutes after we were over the sea, but we did not lose sight of the lights of Dover till we were nearly over France. Ten minutes after 9, barometer 21 inches and 7-10ths; 20 minutes after 9, barometer 21 inches and 3-10ths; from 20 minutes after 9 to half-past 11, we passed over several large lighted towns, our altitude varying from a mile to two miles; there were occasional flashes of lightning. Half-past 11, over a populous district, lighted with numerous furnaces, which I thought to be the neighbourhood of Namur and Liege. Midnight by London time, very dark, the earth being at the same time hidden from our view by an unbroken dense mass of cloud. The stars, which were bright above, showed the extent of darkness below.

"Tuesday, November 8.—24 minutes before 2 o'clock, barometer at 21 inches. From half-past 2 to half-past 3, the earth again obscured by clouds. 4 o'clock, the clouds having dispersed, we saw extensive plains of mist immediately on the earth, which had the appearance of water, the rustling of the forest leaves producing a sound exactly like the waves of the sea. We were aware of these effects, and were also pretty confident that we were going in an easterly direction. 5 o'clock, there was a slight appearance of day-break; 10 minutes after 5, we were at our greatest altitude, the barometer being at 20 inches. 20 minutes after 5, day-break began to dim the stars on the eastern part of the horizon, the

morning-star shining brightly about 25 degrees above. Quarter after 6, the day-break was now beyond every thing magnificent. We had not descended above a quarter of a mile from our greatest altitude. Half-past 7, descended. N.B. This is all London time."

Mr. Holland says, "We have had a delightful excursion, and have been most hospitably received, the whole town being delighted with having descended here. They have lent us the military riding-school for the balloon. It is singular enough that Blanchard descended here about fifty years ago, when he ascended from Frankfort."

PROGRESS OF RAILWAY WORKS.

LONDON AND SOUTHAMPTON RAILWAY COMPANY.

At the Fourth General Half-yearly Meeting of the Proprietors of the London and Southampton Railway Company, held the 30th day of August, 1836, John Wright, Esq., in the Chair,—the following statement of receipts and expenditure up to the present day was read, viz.:—

Receipts.

On calls	£454,343 0 0	
Interest	1,061 11 11	
		£455,404 11 11

Payments.

Expended in raising the capital, procuring the Act of Parliament, &c. . . .	39,040 16 6	
Land and compensation, including charge for surveying and valuing . . .	127,327 6 9	
Conveyancing and law charges	1,510 19 10	
Cuttings and embankments, bridges, culverts, and stores for the same, fencing, draining, &c.	114,316 11 7	
Iron rails, chairs, and sleepers	55,883 17 3	
Engines, waggons, implements and tools, and stores for same	39,891 8 1	
Temporary buildings. . .	3,228 2 9	
Surveying and engineering .	9,092 16 4	
Salaries, wages, rent and taxes, printing and stationery, postages, travelling and all other incidental expenses	7,043 18 11	
Directors' expenses and fines, from the commencement of the undertaking . . .	800 0 0	
		398,135 18 0

Cash in hand	35,945	7	8						
Exchequer bills in hand cost	15,323	6	3						
Funded property in 3 per cent. Consols, invested as required by the 14th Clause of the Act of Parliament	6,000	0	0						
				57,268	13	11			
							£455,404	11	11

Report:—The Directors, in pursuance of the system reported at the last General Meeting, have urged forward the works between London and Basingstoke, with the view of bringing into operation, at as early a period as possible, that portion of the line.

At the last General Meeting it was reported, that about ten miles of the roadway had been formed, although the Company had then been in possession of legal powers, for a period of only twelve months and nineteen days. During the last six months about twelve additional miles have been formed and bridges built for that distance—active operations have likewise been commenced between Southampton and Winchester. From the progress already made, a confident expectation is entertained of opening the railway from London to Kingston, in the spring of 1838; from Southampton to Winchester in the summer of the same year; from Kingston to Basingstoke in the spring of 1839; and from Basingstoke to Winchester (being the completion of the entire line) during the same year.

The Directors, feeling the importance of avoiding the tunnel through Popham Hill, have already made such arrangements with nearly all the land owners, as to justify them in concluding that this desirable object will be effected by consent of the whole, and that there will be no tunnel whatever, on the entire line, from London to Southampton.—Should it, however, be found necessary to apply to Parliament for powers to effect this or other deviations in consequence of any dissent thereto, the Directors trust that the proprietary will approve of such application.

In the original plan of this Railway, the steepest inclination was to have been 1 in 200, but, on the plan now laid out and in progress of execution, that inclination will be flattened to 1 in 250, an improvement which, added to the avoidance of all Tunnelling, would justify an additional expenditure; the Directors, nevertheless, have a full reliance that the whole may be effected with the pecuniary means granted under the powers of the present Act of Parliament.

An Act has been obtained for constructing extensive Commercial Docks at Southampton, which are to be immediately commenced, and a portion of them will probably be completed and opened for trade before the completion of the Railway.

A Branch line from Portsmouth is now being surveyed, to join the Railway between Winchester and Southampton, for which a Company is formed and the money subscribed.

A Company is also formed and the money subscribed for making a railway through the South Western Counties, to unite with the Southampton line between Basingstoke and Winchester.

Another line is in course of survey, from Basingstoke to join the London and Birmingham Railway, thus uniting the Midland and Northern manufacturing Districts with the Southampton line.

The terminus of the Southampton Railway at Vauxhall Bridge, possesses many advantages, not the least of which is, that the Company's Wharf will abut on the River Thames, thereby affording a facility for the transportation of goods, not possessed by any similar undertaking. The convenience of Passengers (who will even then possess the facilities of Steam Boats) may however require a nearer approach to London; it is therefore with pleasure that the Directors advert to a plan for the continuation of the line into London, by which Passengers and Goods can be received and set down near to all the principal Bridges.

The Directors feel justified in declaring their unabated confidence in a most successful result, and their conviction that the undertaking will prove highly beneficial to the Proprietary.

By Order of the Court of Directors,

WILLIAM REED, *Secretary*.

Resolved—That the Directors be empowered to apply to Parliament for an amendment of the Act, to enable the Company to make such deviations in the line of railway as shall avoid tunnelling, or effect such other improvements as may appear to the Court of Directors to be practicable and expedient.

Resolved—That the sum appropriated to pay the expenses of the Directors be increased from 500*l.* to 1000*l.* per annum; such increase to take effect from the date of the last General Half-yearly Meeting.

CHELTENHAM AND GREAT WESTERN UNION RAILWAY COMPANY.

On Thursday, October 6th, a numerous and very respectable meeting of the shareholders in this undertaking was held at the Masonic Hall, Cheltenham, W. H. Hyett, Esq., in the chair.

The Chairman, having read the advertisement calling the meeting together, said it was now his duty to submit to them, on behalf of the Board of Directors, the report they had drawn up, and as that report was unusually full, it would supersede the necessity of detaining the meeting with any remarks of his own.

The reading of the report gave unmixed satisfaction to the shareholders assembled, as it rebutted most explicitly many misrepresentations to which the Company had lately been subjected. Among these misrepresentations was one to the effect that the expenses incurred by the Directors had been so excessive as even to have involved the concern in some embarrassment on that account.

It will be seen that this statement is most triumphantly refuted by the official report, which expressly states that no pecuniary liabilities or debts had been contracted, but that on the contrary, at the close of the Parliamentary business, there remained a clear balance in hand (out of the paid-up capital of 2*l.* 10*s.* per share) of upwards of 1,200*l.*, and, since that period, the expenses have been comparatively trifling. It also appears that great improvements are contemplated in the gradients and curves on the line, by which a considerable saving is anticipated. The report remarks, that though the Company encountered a more severe Parliamentary opposition than almost any other railway, yet the expenses incurred thereby were less than in any other contested railway Bill brought before Parliament during the session; which economical arrangement the Directors, in their report, attributed to the ability and the moderation of professional charges on the part of their engineer and solicitors. It was further stated, that, from certain improvements in the width of the rails, and in the machinery, (which improvements, as we understood from occasional remarks, would be exclusive to this railway and the Great Western,) the journey from Cheltenham to London, it was calculated, would be performed in three hours!

The Chairman, having concluded reading the report, which was received with much applause, entered into some further satisfactory explanations, and observed that, as the Directors pursued their labours, new sources of income developed themselves, which enabled them now to calculate on a much better return. for the capital invested than was originally held out, and it was his decided conviction that the general principles upon which the undertaking was founded when first recommended to the public, were sound and correct. There was one other remark he desired to make, which was, as to its being advisable to proceed with the formation of the line with the utmost industry and despatch, so as to be quite ready to open it for business simultaneously with the Great Western Railway, in 1839.

Mr. Allason moved, and Mr. Watts seconded, a resolution that 800*l.* be voted to defray the expenses of the Directors for the ensuing year.

It was suggested, by two or three proprietors, that the proposed sum was insufficient; and it was observed that, as the Birmingham and Gloucester Railway Company had voted 1,200*l.* to their Directors, it would be unhandsome not to vote as large a sum in this case.

The Chairman said, the Directors only wished to cover their expenses. He begged leave to observe, that they had maturely considered the subject whether they ought to charge their expenses at all; but as it must be granted that business of this description would be better managed by insuring a full attendance of Directors at their meetings, which could hardly be calculated on if

gentlemen were put to a great expense in travelling from a distance to the place of assembling, and in other ways; it was decided that it would be advisable to prevent such a burden, which would bear very hard upon individuals, by proposing a grant of 800*l.* per annum, which it was thought would be sufficient to cover the actual expenses to which the Directors would be put.

Ultimately, on the amendment of Mr. C. Stanton, seconded by Mr. Ireland, it was agreed to substitute 1,000*l.* instead of 800*l.* as the allowance to the Directors.

Mr. David Bowly, in moving the seventh resolution, attributed all the opposition they had had, not to a desire of promoting the accommodation of the Cheltenham people, as they had been told, but the accommodation of the Birmingham Railway Company. He could not himself at all see where the traffic was to come from, that was to support the line they (the Cheltenham people) were so desirous to have formed. He would engage to say, that for one ton of cheese sent to London from Cheltenham, a hundred tons were sent from Cirencester. They would find that twenty-three broad-wheel waggons per week travelled from Stroud and Cirencester to London, while only four, and a light spring van, went from Cheltenham; and two of these were obliged to go round by Cirencester to get an up-loading.

Mr. Brown inquired if it was intended to lay a statement of the intended improvements on the line before the meeting?

Mr. Brunel replied, that he would be happy to answer any questions that might be put to him on the subject, but it was not his wish to enter into a detail of all the alterations contemplated, which would only fatigue the meeting, and might probably interfere with the progress of arrangements with landowners and others, which were in the course of discussion between the Company's officers and the parties interested in property, that would be interfered with. Perhaps it would be satisfactory to the meeting if he merely stated that the nature of the alteration consisted in the improvement of the gradients and curves, that one objectionable curve, in the Sapperton tunnel, which was the subject of so much discussion in Parliament, would be avoided, and the general expense of forming the line, it was calculated, would be materially lessened.

Mr. Brown inquired whether the alteration in laying the rails, in contemplation by the Great Western Railway, would be applicable in this case; and if so, would it not be the means of attaining greater speed?

Mr. Brunel replied—decidedly so. He believed the improvement was perfectly practicable in this case, as well as in the Great Western, and that a great acceleration of speed might be produced with a very small increase of expense. He observed that the object of the improvement was to enable them to attain a greater speed with the same power, or, with the same power and speed, to convey

a greater weight than at present, which would, of course, after the first outlay, be attended with a material decrease of expense. A great many reports had been circulated as to the impossibility of carrying these important changes into effect, particularly in the north, where it was contended that it was impossible to construct engines of the required description. He was happy to state, that these impressions were, in a great measure, removed, and that the Great Western Railway Company has completed engagements for the construction of such engines, which he had no doubt would answer the purpose intended, and be equally applicable to the use of this line. He might also be allowed to state, that the parties who had originally taken the lead, in opposition to the proposed improvements, had altered their views, and shown their confidence by increasing the interest they held in the Great Western Railway.

RAILWAY NOTICES.

Aylesbury Railroad.—A satisfactory arrangement has taken place between the above and the Cheltenham and Oxford Company, the substance of which is, that the latter Company have agreed to bring their line through Aylesbury to Tring.

Brighton Lines.—The greatest exertions have been used to render some of these lines unexceptional. Cundy's Line, as it was called, but who has now nothing to do with it, has been very much improved by Mr. Mills, the engineer. The nine miles of embankment have been got rid of; so also has the formidable cutting of Box-hill. The marshes the engineer has prudently left to the
session of their proper inhabitants, the quacking
frogs, and has taken more elevated, and conse-
lid ground. By this means he has much improved
We are likewise informed that the Brighton ter-
very much approved of by all parties at Brighton.
e, in grateful compliment to the Brightonians for
arks of favour with which they regard this line
as been changed from LONDON AND BRIGHTON RAILWAY, to BRIGHTON AND LONDON RAILWAY. If so, it displays great good sense in the Directors.

Sir John Rennie, we hear, takes nearly the track he first chalked out several years back. It is said he has also very materially improved his line; but the particulars have not transpired.

Mr. Stevenson's camp is reported not to have been one of unanimity. Some say he has sounded a retreat and given up the command; but it is generally rumoured that Mr. Goldsmid, the mighty man of money, is no longer with them.

Of the other lines little is said and less known. If they are doing any thing, it is *sub silentio*; "slow, perhaps, and sure," but we hope not "slow to begin, and sure to come too late."

Bath and Weymouth Great Western Union Railway.—Application is to be made to Parliament next session, for an Act to construct a Railway from Bath to Weymouth. It is intended to pass through or near to Frome, Bruton, Wincanton, Sherbourne, Dorchester, &c., and will derive an increase of commerce from many manufacturing and coal districts, such as Bradford, Trowbridge, Westbury, Warminster, the Somersetshire collieries, and the richest agricultural district of the kingdom.

The London and Birmingham Railway.—The Directors, it is said, have thought it requisite to increase the weight of the rails, which are wrought iron, from 50lbs. per yard, as originally intended, to 75lbs.

Boston and Nottingham Railway—This railway, when completed, will connect the midland counties with the eastern coast, of which Boston is the natural outlet, in a manner which must be mutually beneficial. The corn, flesh, wool, and fish of the one, and the manufactures of the other, will present, in their transit, an ample remuneration to the shareholders; and in connection with steam conveyance by sea from Boston to London, about to be commenced, will confer an incalculable benefit on the whole country.—*Derby Reporter.*

The "Blackwall Railway Company," it is reported, are in treaty with the Directors of the East India Company for the purchase of the East India House, for the purpose of converting it into a depôt.—*Birmingham Herald.*

Branch Railway to Leek.—Efforts are making to induce the South Union Company to make this branch, under the presumption that it will be highly advantageous.

Cheltenham, Oxford, and Tring Rail
a deputation from the Cheltenham, Ox
Company, have (says the *Oxford Journa*
this city, for the purpose of submitting
sity to obtain their support, as well as th
national undertaking; and we are happ
met all the countenance which this proje
railway communication which it affords t
ward, through Cheltenham, Gloucester, a
with the northern and eastern counties, C
tonshire, Lincolnshire, Bedfordshire, I
and Norfolk.—*Birmingham Herald.*

City of London and Richmond
Parliamentary plans, sections, and b
with this undertaking, have been
of the peace, &c., and with the cl
through which the railway is intend

set of plans, we are informed, will probably have never been produced before the Houses of Legislature than these. The proprietors, lessees, and occupiers on the line are almost unanimous in support of this undertaking, which will be in itself of vast advantage to nearly all the railways approaching the metropolis, and likewise the originator of an impulse toward improvement in parts of this vast city where it is most required. There is little doubt, whichever Brighton line is successful, but that it will run with the City Railway, as by so doing the great object of a *North and South Junction* will be at once effected.

Dublin and Drogheda Railway.—The *Dublin Evening Post* says, of the Dublin and Drogheda Railway:—" Here are public works which will really be beneficial, now and hereafter, to the country—now, as they will give immediate employment to our superabundant population; hereafter, as they must lead to similar enterprizes, not only in the north but in every part of Ireland; and ultimately as they will bring all parts of this country, as it were, together.

The *Durham Junction Railway Company*, established by Act of Parliament, for making and maintaining a railway from Hartlepool Railway, near to Moorsley, to the Stanhope and Tyne Railroad, in the township of Usworth, intend to apply to Parliament in the ensuing session, for powers for making two branch railways adjoining thereto; the one commencing at Morton, in the parish of Houghton-le-Spring, and extending to St. Giles's Gate, in the city of Durham; the other commencing at Bourn Moor, in the parish of Houghton-le-Spring, and terminating near to a carriage road, called Newbottle-lane.—*Newcastle Journal.*

Dublin and Armagh Railway.—There is a rumour in circulation that a union is contemplated between the promoters of the Dublin and Armagh Inland Railway and the Coast Line Railway. We trust this rumour will prove correct, and that a line may be formed beneficial to the country generally, without reference to individual advantage.—*Drogheda Journal.*

Eastern Counties' Railway.—A rumour is abroad that Lord Peters intends to file an injunction to restrain the proceedings of this Company. Mr. Labouchere, it is also said, is about to do the same.

Great Northern Railway.—The Great Northern Railway Company have given notice of their intention to apply to Parliament, in the ensuing session, for powers to extend their line from the Tees through Northallerton Thirsk and Easingwold to the York and North Midland Railway at Hob Moor, near York; to construct a bridge across the River Ouse, at York; to form a branch from a point in the present line to the city of Durham, and for other important objects.—*Newcastle Journal.*

The Gloucester and Hereford Railway Companies, it is announced, have just effected a junction, and that they have re-

solved upon adopting the line sanctioned by the Hereford County Meeting, by Ledbury, with a branch from Nuppingend to Ross, making the distance from Gloucester to Ross 15 miles, and from the former place to Hereford, 27½ miles.—*Worcester Herald.*

Gloucester and South Wales Railway.—A general meeting was recently held at Gloucester, when it was resolved—"That a Company be formed to construct a railway from Gloucester to Cardiff, passing through or near Newnham, Lidney, Chepstow, and Newport; and that a capital of 900,000*l.* be raised in shares of 100*l.* each."—A Committee was appointed to conduct the application to Parliament in the ensuing session, for powers to establish the company, and to construct the railway.—*Birmingham Herald.*

Greenwich Railway.—A paragraph, said to be from the "Dispatch," has been sent to us by an *anonymous* correspondent, making the most unfounded statements against this company. The Managing Director is said to have 800*l.* per annum salary. We have good authority for saying that he has no such salary by several hundreds per annum. The Secretary is also said to have 500*l.* per annum, which is equally untrue. The Engineer is given 800*l.* per annum. In truth, he has not a shilling salary; he has a trifling per centage on the Parliamentary Estimates to pay himself, office, men, travelling expenses, &c. &c. To a "Sub-Engineer," is given 300*l.* per annum; Who is he? A debt of 60,000*l.* is assigned to the Contractor; we believe this gentleman would be glad to give the writer 59,000*l.* to prove it. Indeed, the whole article we believe to be nothing but a tissue of malevolent falsehoods. We are by no means pleased with this company for not having opened their line; but we really cannot vent our anger by giving countenance to such wicked untruths.—Ed.*

Hull, Lincoln, Newark, and Nottingham Railway.—A line of railroad is in contemplation from the Humber side, near Goxhill, through the gorge of the Wolds at Melton Ross, near Brigg, and so by Lincoln and over the Witham, and then on to the levels to Newark and Nottingham, about 79 miles; the estimated cost of which would be 800,000*l.*

The Hull and Selby Railroad.—The line of road we understand is now staked out, and preliminary matters are in full forwardness for the commencement of the works.

Manchester South Union Railway.—Mr. Stevenson has published his report of the proposed line of railway, sanctioned and recommended for adoption by the Directors of the Manchester South Union Railway Company, from Manchester to Tamworth; there joining the Derby and Birmingham Railway, and by the projected branch from the latter town to Rugby, running into the Birmingham and London line. From this report it will be seen, that every place of the least importance throughout the whole distance, 70 miles, will be accommodated by the main line of the

* We have just heard that there is no obstacle to opening the Greenwich Railway before our next No. appears.

South Union Railway. The line from Manchester includes Stockport, Macclesfield, Congleton, and the Potteries; the latter district, comprehending Tunstall, Burslem, Hanley, Shelton, Stoke, Lane End, and Stone; and then passes on to Haywood, Rugeley, Lichfield, and Tamworth. There are, it appears, to be three branches from it; one to run into the Derby and Birmingham Railway beyond Burton, near Arlewas, to accommodate the traffic from Derby, Nottingham, and the eastern parts, to Manchester: another from the main line, near Stone, to join the Grand Junction, to serve the interests of the Potteries and Manchester; the traffic of which districts is destined for Birmingham, Wolverhampton, and the West of England.

A great portion of the line will be nearly level, while of the remainder, no gradient will exceed more than 16 feet per mile, excepting for a distance of five miles, and that will only be 20 feet per mile. Even this may be avoided by a cutting which is quite practicable, being simply a matter of expense.—*Derby Mercury.*

Manchester, Leeds, and Goole Railway.—A line of railway is projected from Altofts to Goole, carrying forwards the Manchester and Leeds, and the North Midland Railways in the most direct and practicable line, to a commodious shipping-place. The country is exceedingly favourable, a great portion of it being perfectly level; and, besides the absence of all expensive masonry, another feature in favour of the scheme is, that no costly depot or establishment will be required; the means of accommodating the trade at Goole, to any extent, being in the hands of the proprietors of the Ayre and Calder navigation, who are ready, by extensions and improvements, fully to keep pace with, or even to anticipate the requirements of commerce.

Maryport and Carlisle Railway.—Mr. Stevenson's official report has been published, from which it appears that the ground along the line is highly favourable, and that the expense will be small compared with the length.

Northern and Eastern Railway.—We understand that the Directors of the Northern and Eastern Railway Company have determined on commencing their line from London, and bringing mile after mile, as completed, into immediate operation, by which means the shareholders will receive a dividend on the capital expended before another call is made. The operations are to commence at Kingsland, and this trunk line to Cambridge will ultimately extend in a direct course, and with very easy gradients, through Lincoln to York, to the very centre of Scotland. The distance by this railway between London and York will be twenty-four miles shorter than by the London and Birmingham.

Nottingham Railways.—A very full meeting of the Corporation of Nottingham has been held, to consider the propriety of encouraging and supporting the projected railways to that town. The subject was ably argued, and a great majority decided in

favour of the motion. A Committee was appointed to act on behalf of the Corporation with the Directors of the projected lines, and the one from Hull, the chief sea-port for the North of Europe, was particularly applauded. That from Boston was also favourably received.—*Birmingham Herald.*

Railway for the Potteries.—The *Staffordshire Advertiser* says, "We congratulate the inhabitants of the Staffordshire Potteries on the certainty that a main line of railway will now pass through their important district. Both the Cheshire Junction Company, and the South Union Company have determined, in the event of being successful in their application to Parliament, upon accommodating the Staffordshire Potteries."—*Birmingham Herald.*

Preston and Lancaster Junction Railway.—We understand that the following is fixed upon as the line of road which is intended to connect Preston with Lancaster. It will commence in Dock-street in this town, where the junction will be made with the North Union Railway, and pass thence across Lower Pitt-street and Marsh-lane, through the Maudlands, and over Water-lane, and the Lancaster Canal, near to Mr. Dawson's factory. Its course will then be to the east of Cadeley Mills, passing the east side of the Roman Catholic chapel and school, at Myerscough; it will thence proceed to the east of Anderton Fold, and cross the new turnpike-road near the White Horse, in Myerscough. The route will be continued over Bilsborough-lane, and the river Brock, east of the Whim Farm-house, crossing the river Calder, and the Garstang and Chipping-road, passing thence to the east of the canal, close by Woodacre-hall, east of Richmond's-house, and west of Scorton. Its intended direction is then over the river Wyre, east of Swan's Hill-burn, west of Cleveley, and holding to the east of Whinny-brows plantation, to cross the old Lancaster road, continuing a little west of Spout-house and Fox-holes, again to cross the old Lancaster road, and the road leading to Wham-house, near their junction, to the east of the Old Bay-horse; it will continue east of the hole in Ellal, and cross the new turnpike-road, a little to the north of Wilson-house, the Conder, and pass the west side of the silk-mill at Galgate, the turn near Burrow Rock, and through the lands of H. Hargreaves, Esq., to its *terminus* at Lancaster.—*Preston Chronicle.*

Preston and Wyre Railway and Harbour.—The Preston and Wyre Railway and Harbour Company held, on the 9th instant, their second general meeting, P. Hesketh Fleetwood, Esq., M.P. for Preston, in the chair. The meeting, after the Directors' Report, which stated the progress that had been made in the works, and the favourable and prosperous state of the Company, had been read, proceeded to elect six Directors, in the room of those who had gone out, by ballot, pursuant to the provisions of their act of incorporation, and to adopt a short but highly important deviation on the line contained in the first contract, whereby a large saving would result to the Company.

Thanks were in due course voted to the Directors, and other officers of the Company, and to the Chairman, for his able conduct in the Chair.

Letters from Mr. Thomas Pitt, of Great Yarmouth (formerly sailing-master to Lord St. Vincent, and since largely concerned in shipping), and from Captain Edward Smith, R.N. (who has, for many years since the war, been actively engaged in the commercial service), were read, and appeared to us particularly deserving of attention, coming as they did from practical and experienced men, and altogether confirming the safety and goodness of the Harbour of Wyre, upon which the success of this undertaking so materially depends; it being clear that, if the Harbour be such as it is represented, its safety and nominal dues must draw an immense traffic to it, so closely connected as it will be by the railway with the leading manufacturing districts of Lancashire and Yorkshire.

Railroad from Oxford to Cambridge, &c.—A meeting of the principal inhabitants of Luton, Bedfordshire, was held at the George Hotel in that town, and resolutions passed to support the proposed line of railway from the termination of the Cheltenham, Oxford, and Tring line, to Cambridge and the eastern coast, Edmund Waller, Esq., in the Chair. Forming a Junction with the great Eastern and Western lines, it will cross the London and Birmingham line near Tring, in Hertfordshire.

Railways in Ireland.—His Majesty has been pleased to order a Commission to pass the Great Seal, appointing Thomas Drummond, Esq., Under Secretary of State in Ireland; Colonel J. Fox Burgoyne; Peter Barlow, Esq., Professor of Mathematics at Woolwich Military Academy; and Richard Griffith, Commissioners for considering and reporting upon a general system of railways in Ireland.—*Mining Journal.*

Sheffield and Midland Railway.—A Meeting of the Committee appointed to promote this object, at which Lord Wharncliffe and several of the Directors of the Midland Counties Railway attended, was held in the Cutler's Hall, Sheffield, on Monday week—Hugh Parker, Esq., in the Chair—to receive the Report of Messrs. Leather and Locke, the engineers. It was unanimously resolved that a company should be formed to carry a line from Sheffield to Woodhouse Mill, and that the Midland Counties Company then take up the line from Clay Cross to the Trent, to join the Midland Counties Railway, which, if completed, would afford the best line of communication from Sheffield to the metropolis.

Snow on Railways.—Much curiosity was manifested on the 29th October, in consequence of the heavy fall of snow, which, it was feared, would greatly impede, if not prevent the running of the trains on the Greenwich Railway; but not the least inconvenience was experienced, and the carriages ran as usual.

Whitby and Pickering Railway.—The amount of traffic and number of passengers that have been conveyed along this line,

which has now been opened to the public for the last four months, have far exceeded the calculations of its most sanguine supporters. The gross receipts for the last four months are equal to 9*l.* per cent. per annum on the paid-up capital of the proprietors.

FOREIGN RAILWAYS.

Railway between Brussels and Paris.—This proposed undertaking is said to find favour with the French Government. King Leopold is much interested in it, and its promotion is now said to be one of the main objects of his late visit to Paris. His Belgian Majesty has found a mine of wealth in the Antwerp and Brussels Railway, of which he is a large shareholder.

Railroad across the Isthmus of Panama.—Colonel Charles Biddle, a citizen of the United States, in conjunction with a few capitalists in this country, have obtained the contract for this road, which promises, if completed, to be of immense importance to our commerce, and to the whole world. It must become, in a few years, the highway of the nations to the Pacific Ocean, and will enable our whaling ships to make their return every six months, instead of three years, as well as save a dangerous voyage around Cape Horn.—*American Paper.*

Railroads in Belgium.—The works of the iron railroad proceed with activity. The solicitude of my Government in this great enterprise coincides with the opinion of the public, who see, in the execution of these works, a new source of prosperity and national glory.—*Speech of the King of the Belgians at the opening of the Belgian Chamber*, 8th Nov.

ERRATA.

Page.
27, $\frac{N}{n} = \frac{D}{d}$ read $\frac{N}{n} = \sqrt{\frac{D}{d}}$
33, line 7, for *or stop*, read *or to stop*.
These two Errata refer to the 1st edition of No. 1.
91. last line, for $20 \times 17\frac{1}{2}$, read $20 + 17\frac{1}{2}$.
92, line 27, dele *in*.
104, line 15, for *This theory*, read *His theory*.
107, lines 12 and 23, for *phænomena*, read *phænomenon*.
109, line 7, for *lower*, read *higher*.
220, line 5, for *Houses are*, read *House is*.
——— 6, for *they*, read *it*.
For errata of No. 7, from p. 249 to 296, see p. 341, and a leaf added to No. 8, to supply pp. 251 and 252. In the corrected p. 252, for *And*, the first word, read *and*.
312, line 7 from bottom, for *sentences*, read *sentence*.
321, line 12 from bottom, for *mutations*, read *nutations*.
345, line 5 from bottom, for *endured*, read *consumed*.
348, line 5 from top, for *one side*, read *the side*.
364, line 16, for *projectors*, read *proprietors*.
367, line 31, for *transit by animate power*, read *transit and by a new power*.
372, line 8, for *the*, read *if the*.
406, line 15 from bottom, for *level*, read *bevel*.

2,800	......	(4) Glasgow and Falkirk Junction ...	50	3									
		(2) Grand Junction	100	50									
		(3) th of England...........	......	2									
		(5) thern	100	2									
25,000	......	(2) stern	100	30	$40\frac{1}{4}$	41	41	$39\frac{3}{4}$	37	$35\frac{1}{2}$	37	35	$36\frac{1}{4}$
2,000	......	(2)	100	100									
11,000	......	(4)	20	1	$\frac{3}{4}$	......	......	$\frac{7}{8}$	......	$\frac{5}{8}$	......	$\frac{7}{8}$	
8,000	......	(2) Selby	50	5									
2,100	......	(1) Leeds and Selby	100	100									
1,500	......	(1) Leicester and Swanington	50	50									
5,100	4l. per c.	(1) Liverpool and Manchester	100	100									
		Ditto, $\frac{1}{4}$ shares	25	25									
10,000	......	(4) London and Brighton (Stevenson's)	100	5	7	7	......	7	7	7	$6\frac{3}{4}$	6	$5\frac{1}{2}$
45,000	......	(5) ——— (Gibbs) ...	20	1	$\frac{5}{8}$	......	......	......	......	......	$\frac{5}{8}$		
16,000	......	(5) ——— (Rennie)....	50	3	1	$\frac{3}{8}$	$\frac{5}{8}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{4}$	......	......	$\frac{1}{2}$
8,000	......	(5) ——— (Cundy)	100	3	......	$1\frac{3}{8}$	......	2	......	......	$1\frac{7}{8}$	$1\frac{3}{8}$	$1\frac{3}{4}$
12,000	......	London and Blackwall	50	3	$1\frac{3}{8}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{3}{8}$	......	1	$\frac{7}{8}$	1	1
20,000	4l. per c.	(2) London and Greenwich	20	20	$22\frac{1}{4}$	22	22	$22\frac{3}{4}$	......	22	$21\frac{3}{4}$	21	$20\frac{1}{4}$
		Ditto, Bonds.											
25,000	......	(2) London and Birmingham	100	70	192	......	137	$196\frac{1}{2}$	134	190	130	127	127
		Ditto, Bonds, 1834.		......	......	......	......	......	......	......	......	99	
20,000	......	(2) London and Southampton	50	30	$18\frac{1}{2}$	18	18	......	$19\frac{1}{2}$	19	$17\frac{1}{2}$	18	
7,000	......	(3) London and Croydon	20	13	10	$10\frac{1}{8}$	......	$10\frac{5}{8}$	......	......	......	$9\frac{1}{2}$	$9\frac{3}{4}$
12,000	......	(3) London Grand Junction	50	2	$1\frac{1}{4}$	$1\frac{3}{4}$	$1\frac{1}{4}$	$1\frac{1}{8}$	$1\frac{3}{8}$	$1\frac{1}{4}$	......	$1\frac{1}{4}$	
10,000	......	Manchester and Leeds	100	5	12	......	$9\frac{1}{4}$	$8\frac{1}{2}$	......	7	$8\frac{1}{2}$	8	$8\frac{1}{4}$
1,000	......	(5) Manchester and Oldham............	100	3									
10,000	......	(5) Manchester South Union...........	100	2	$3\frac{1}{4}$	$3\frac{1}{4}$	$3\frac{1}{4}$	3	$2\frac{3}{4}$	......	......	......	$2\frac{3}{8}$

PRICES OF RAILWAY SHARES (Continued).

Number of Shares.	Dividend per Ann.	NAMES OF RAILWAYS.	Amount of Shares.	Sum Paid.	Closing Price of Shares in London Markets on								
					Oct.	November							
					28.	1.	4.	8.	11.	15.	18.	22.	25.
			£.	£.									
		(3) Midland Counties	50	5									
		(3) North Midland	......	10	......	$8\frac{1}{2}$	$13\frac{1}{4}$	13	$12\frac{1}{2}$	$11\frac{1}{2}$	$11\frac{3}{4}$	$11\frac{3}{4}$	$11\frac{1}{2}$
		(3) Northern and Eastern...............	100	6	$3\frac{3}{4}$								
2,500	......	(2) Preston and Wigan...............	......	20									
2,600	......	(2) Preston and Wyre	50	18									
4,000	......	(3) Sheffield and Rotherham	25	6									
1,000	6*l.* per c.	(1) Stockton and Darlington	100										
1,500	......	(2) Stanhope and Tyne	100	100									
3,000	......	(4) South Durham	50	$2\frac{1}{2}$	$\frac{1}{4}$	......	$\frac{1}{4}$	......	......	$\frac{1}{8}$	$\frac{1}{8}$		
28,000	......	(3) South-Eastern and Dover	......	2	$2\frac{3}{8}$	$2\frac{3}{4}$	$2\frac{1}{2}$	2	$1\frac{3}{4}$	$1\frac{7}{8}$	$1\frac{3}{4}$	$1\frac{7}{8}$	$1\frac{1}{2}$
		(4) South Midland	50	1	$\frac{5}{8}$								
40,000	......	(4) South-Western (Stevenson's) ...	50	1	......	$\frac{5}{8}$	......	......	......	......	$\frac{1}{2}$	......	$\frac{1}{2}$
9,000	......	(3) Thames Haven	50	$2\frac{1}{2}$	......	......	......	......	......	......	......	......	$\frac{1}{2}$
6,600	......	(4) Victoria	25	1									
6,000	......	(3) York and North Midland	50	3	......	......	......	......	......	......	......	2	$1\frac{7}{8}$

The above, as we have stated, are the closing prices of the day. They are the prices at the last business transactions. But it is to be understood, that there is generally a difference of $\frac{1}{4}$ in the Stock Exchange between the prices a person can sell at, and those he can buy at, the former being less than the latter. The prices obviously include the sum paid for the Share; and therefore the difference between them and the price paid on the Share is the premium or discount of the Share. Where there are blanks no business was done. We have carefully corrected the list of the number of Shares wherever we could; but should any errors be left, we shall immediately correct them when pointed out.

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INDEX OF SCIENTIFIC AND MISCELLANEOUS NOTICES.

INDEX TO RAILWAY NOTICES.

RAILWAY NOTICES.

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